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Trade Enjoys a Most Vigorous Recovery

From Starvation to Satiety—Chief Influence the Influx of War Orders —Railroads Again Become Buyers

GENERAL REVIEW OF THE COURSE OF BUSINESS IN 1915

REFRESHING and inspiring was the change from depression to activity wrought in 1915. Those who were weary, almost to hopelessness, with the long fight against adversity, which began in 1913 and seemed destined to continue indefinitely, have been reinvigorated, and again can make plans for the future with some confidence. The dismal array of idle workshops, cold blast furnaces, dead steel works and silent rolling mills has been touched by the magic hand of a reviving demand and quickened into life and renewed energy. Everywhere has idleness given way to full employment, busy workmen thronging factories whose gates had long been closed against them. The public employment bureaus have almost disappeared, for ample earnings have filled empty pockets and households which had suffered bitter privation for two winters are again abounding with comforts, if not luxuries. Employers are no longer studying their lists of workmen to see who can be laid off with the least suffering among dependents, but are seeking more men for the purpose of getting out increased product. Instead of exhausting their energy and ingenuity in the effort to get orders to enable their works to be run on part time, manufacturers are planning enlargements, extensions and even wholly new producing units to meet the continually increasing demand. Not the least important feature of the marvelous change wrought in the condition of the iron and steel trades is the improvement in financial results. A year ago the manufacturer able to show a profit on his operations was an exception. To-day any kind of a plant must be run most inefficiently to have its balances written in red ink.

FEW ENCOURAGING FEATURES AS YEAR OPENED

The year opened with steel works operating at only about 40 per cent of their capacity. While this was an improvement on November and December, when the productive rate was only about 25 to 30 per cent, it was too low to enable manufacturers to earn more than mere running expenses, many falling short. Readjustments of wages were made, affecting more particularly the workmen receiving the highest wage rates. December buying had been comparatively liberal, stimulated by the announcement that on Jan. 1 an advance would be made of $1 per ton on steel bars, plates and shapes, but this was followed by a relapse into dullness.

A few branches of the trade were conspicuously active, due to special reasons. The tin-plate mills were well supplied with orders, taken for the season's requirements from manufacturers of cans and other containers, to whom inducements of very low prices had been made. Machine-tool builders were also enjoying a large business with European belligerents, supplying machines for the manufacture of war munitions, this demand more than compensating for any lack of domestic trade. Shipbuilding was very brisk because of the serious scarcity of ocean vessels. But iron and steel manufacturers generally suffered from the absence of railroad buying and the low rate of consumption by the agricultural implement industry and other important interests. Prospects for steel-rail orders were far from bright, contracts under negotiation being fewer and smaller than at the opening of 1914. Canadian competition for United States rail orders was also disquieting, prices much under ours being named to railroads in the Central West.

IMPROVEMENT DID NOT START SUDDENLY

In spite of so many unfavorable conditions, a creeping improvement began to make itself felt while the year was still young. Here and there a courageous and more confident spirit was shown by those who contemplated undertakings requiring a considerable investment of capital and involving heavy purchases of steel products. By the close of January the swelling of the general demand for their products had brought the productive rate of steel works up to 55 per cent of their capacity. The production of pig iron, which had been at the rate of about 18,000,000 tons per annum in December, rose to over 19,000,000 tons in January, due

to the enlarging operations of the steel companies. The wire trade felt the impetus of an expanding demand for barb wire from the European belligerents and conditions were deemed propitious at the close of January for an advance of $1 per ton on all wire products for the purpose of hastening domestic specifications. About this time, also, spelter began its sensational upward flight, causing galvanized products to advance. But the sharp rise in galvanized sheets, decreasing their consumption, seriously disturbed the black sheet trade by greatly enlarging the competition for orders for black sheets.

STEEL MARKET MORE ABLY HANDLED THAN PIG IRON

The manufacturers of heavy steel products endeavored to strengthen the market in February by announcing an advance of $1 per ton in the March price on bars, plates and shapes and a further advance of $1 per ton in the April price. While their efforts were not wholly successful, as some makers were less insistent on these advances than others, not only was demoralization prevented but business in this branch of the industry steadily improved its footing by gradually working up to the higher future prices. For a time steel plates lagged behind, due to the slack demand for steel cars, but after a few months they not only displayed equal strength but even rose to higher levels than bars and shapes.

In marked contrast to the shrewd procedure of the steel makers was the disorganized condition of affairs among the manufacturers of pig iron. Disturbed by the feebleness of the demand for foundry iron, and apparently without hope that the steel makers would take their surplus output, especially as some steel companies having blast furnaces were active competitors for pig-iron business, the owners of important merchant furnace interests went on a still hunt for orders and in March booked heavy contracts for delivery as far ahead as the last half of the year, making prices in extreme cases as low as $11.50, Buffalo, and $9.25, Birmingham. These prices attracted speculators, who bought large blocks of pig iron, principally at Buffalo and Birmingham, to hold for an advance.

EFFECT OF WAR ORDERS FELT IN SECOND QUARTER

European war orders—for steel bars for shrapnel, barb wire and a few other products—featured the steel trade to some extent early in the year but it was not until the second quarter that they began to appear in good volume. From that time forward their stimulating influence was felt. These orders became bewilderingly large in May. An important event in June was the decision by the United States District Court of New Jersey, sitting as a Circuit Court of Appeals, in favor of the United States Steel Corporation in the Government suit for its dissolution, giving much confidence to the trade.

Steel-bar manufacturers steadily increased their operations to capacity, domestic consumers buying freely for their future requirements as they perceived the danger of their usual sources of supply being cut off. Orders for large rounds for shrapnel glutted the merchant mills having facilities for their production and the rail makers, whose mills were only spasmodically running on railroad business, diverted these mills to the production of such rounds, receiving 2 to 3c. or more per lb., realizing a far larger profit than in making an equal tonnage of rails. But in June the buying of rails by domestic railroads began with some vigor. The Pennsylvania Railroad distributed orders among several steel companies aggregating 155,000 tons (afterward increased to 175,000 tons) and other roads bought good quantities. In July a scarcity of open-hearth steel began to be felt and steel makers having full order books for finished products bought billets from others.

HUGE VOLUME OF EXPORTS

The influence of the European war went much further in increasing our export trade than in the demand for purely war material. Orders for steel rails, steel blooms, billets, tin plates, steel railroad ties and a variety of other products, including pig iron, which would ordinarily have gone to some one of the belligerent countries, came to the United States. From month to month the tide of this buying continued in full force, and its volume was indicated in the Government statistics of exports, reaching in August the record figures of 401,000 tons for tonnage commodities. Subsequent months would probably have attained even higher quantities if ocean carrying facilities had been equal to the expansion. While the foreign demand was steadily growing, the domestic trade with automobile and implement manufacturers as well as other important consumers expanded. Even the railroads felt the influence of improved steel trade conditions and became free buyers of rails, locomotives and cars. Operations of steel mills increased rapidly, apparently unaffected by the restrictions imposed by Great Britain on exports of British ferromanganese, an essential source of supply for many of our steel manufacturers. From a rate of about 65 per cent of capacity in March, 75 per cent or more was attained by May, over 90 per cent by July, and such an excess of demand over supply by October that premiums over regular prices began to be offered on numerous steel products, this situation becoming even more aggravated in November and December.

Prices of nearly all steel products moved upward throughout the year, about the only exception being black steel sheets, and this branch of trade only receded temporarily. The advances were so frequent and so general that it would be tedious to enumerate them here. Tables of prices, given elsewhere in this issue, tell the story of this change in the condition of the steel trade which has gladdened the hearts of all steel manufacturers.

HOW PIG-IRON PRODUCTION LEAPED

If one should merely scan the monthly figures of pig-iron production for the year, knowing nothing else about the course of the trade, he would infer that this branch of business had experienced its greatest boom. The output in January was at the rate of about 19,000,000 tons a year, or a little over 60 per cent of the make in a year of normal trade. By April the rate of production had grown to 25,000,000 tons, by July to 32,000,000 tons, by October to 37,500,000 tons and by December to over 38,000,000 tons, double the January rate, and far in excess of any previous record. This country is now

producing more pig iron than the whole world made so recently as 1900. Notwithstanding this stupendous showing as to output, prices of pig iron for a considerable part of the year were by no means strong. Makers were timid. Of course, the great increase in the production of pig iron was due to the activity in the steel trade but the merchant furnacemen should perhaps have foreseen that this would eventually lead to a greater consumption by miscellaneous consumers.

As they look back over the year, pig-iron manufacturers, to use the language of a historic British character, must be amazed at their moderation. Up to July an advance of 25c. per ton on any grade of pig iron was an event, and it was not until August that rises of 75c. to $1 per ton began to be recorded. Even in September pig-iron makers were not sure that the trade was on a solid footing as some of them invaded distant markets; southern Ohio, for instance, taking basic pig-iron orders in eastern Pennsylvania, underselling the Pennsylvania furnacemen. By this time, however, it had become clearly manifest at most iron trade centers that buyers were more interested in having their orders placed than in finding the cheapest seller and prices began to climb on all grades. As with steel prices, advances on pig iron did not check buying in November and December, but stimulated it.

YEAR CLOSED WITH TRADE BUOYANT

At the close of the year the production of iron and steel was at a rate far in excess of previous attainments in the history of this country. It is believed that the output of steel ingots is closely approaching the 40,000,000-ton rate per annum, which authorities in the trade had estimated some years ago might be reached by 1920. Every available steel plant, rolling mill and blast furnace was in active operation, with sufficient orders booked to insure running to full capacity far into the summer and consumers endeavoring to place contracts for even more distant delivery. The trade has had previous experiences of great activity and insatiable demand, but never before had been seen anything approaching the conditions existing at the close of 1915.

Details of the course of prices throughout the year and of developments in the various branches of the trade in leading commercial centers will be found in the reports and price tables which follow.

The Chicago Iron Trade in 1915

BY O. J. ABELL

Throughout 1915 the activities in iron and steel in the Chicago district more accurately reflected the state of business originating within our own borders than did the conditions prevailing in any other principal market center. Other years have brought contrasts between poverty and prosperity as sharp as that between the 30 per cent operation of the local steel mills in December, 1914, and the 130 per cent schedule upon which some of them are now operating, but with respect to causes and the distortion of natural relationships the experience of the year was unique. Developments in the West have been continuously a step behind the position of the industry in the East. But here, as elsewhere, the dominating influence has been the almost insatiable demand from abroad for the products of our mills and factories, and though Chicago, being disadvantageously situated with respect to export trade, participated only as the more favorably located districts became filled up, the overflow was finally of such volume as to bring conditions here to the common level of over-sold capacity. Exports from Chicago to the Orient and to Europe via Gulf ports were, however, among the phenomena developed out of the unusual conditions.

ADVANCES SLOW IN FIRST FEW MONTHS

The first half of the year had almost been completed before there was any substantial evidence within this district supporting the slow but uninterrupted increase in the prices of iron and steel which resulted in an advance of about $2 per ton up to July 1. In this advance Chicago quotations had simply followed Pittsburgh. Simultaneously with the upward movement in prices came reports of heavier mill operations, particularly in the East, although in the West the mill schedules had also improved to a gait of 65 per cent in the first three months.

This improvement was not generally comprehended, nor was it understood from what sources the business was coming, inasmuch as all the evidences pointed to a minimum of activity on the part of domestic consumers. In fact, so much secrecy surrounded the earlier placing of orders for ammunition materials that it was not until the steel-bar mills throughout the country were operating at full capacity, which condition existed before the close of the first half, that recognition of the source of these orders dawned upon the market. Even then there was little appreciation of the extent to which the demand for exports was dominating the available mill capacity.

In the West a better vision was had than in the East, for the reason that here many lines of manufacture which in more favorable locations had turned to the furnishing of war materials and machinery, and thus could be considered responsible for a large share of the heavy mill business, were struggling along with little or nothing to do. It was therefore obvious that the Western mills were operating on orders originating through other than normal channels. To this earlier realization of the situation may be attributed the fact that Western consumers were the first to become aroused to the need of protecting their operations in the last quarter of 1915 and the first half of 1916 against a shortage of raw materials. While it was true that the majority of users of steel found it difficult to foresee a shortage in rolled-steel products when their own businesses were far from good—and there are still many manufacturers lacking adequate raw material supplies for their expected operations—the West has provided for itself much better than has the East.

WHEN THE REAL PINCH CAME

In the West the real pinch has come in the last three months, although as early as July the Gary works began to buy steel scrap to relieve its impending shortage of hot metal. Of the increase in the contract price of heavy finished steel products from 1.10c., Pittsburgh, in January to 1.80c., Pittsburgh, in December, an advance of $14 per ton, approximately $10 was made in the last quarter. A parallel is found in the prices of pig iron and scrap. And the course which prices took was simply a manifestation of the development of conditions of supply, which rapidly changed deliveries of two to three weeks into six months and finally brought about the complete withdrawal from the market of the principal producers.

Meanwhile, as an evidence of the incongruity that existed between the sold-up condition of the mills and the paucity of business with the rank and file of consumers, the demand for material out of stock, which usually keeps pace in its increase with the lengthening of mill deliveries, remained at a conspicuously low level. Only in the last two months of the year did the improvement in nearly all lines of business in this country, using iron and steel as raw materials, become sufficiently important to be apparent, and there can be little doubt that the heavy contracting by consumers in the last quarter was occasioned as much by fear of a materials shortage as by the demands of business on their books. Railroad buying of cars and track materials was an outstanding example.

RAILROAD BUYING SLOW TO DEVELOP

For the greater part of the year railroad purchases were below normal. The first period of rail buying was strung out through the first half, and in February, March, April and June an aggregate of nearly 400,000 tons was bought or reserved. On Feb. 8 the rail mill of the Gary plant, which had been idle for a number of months, was started up at a limited gait, with rollings scheduled for about two months. In the last few months of the year the railroads again entered the market for both prompt shipment and first half deliveries, but at no time in the year was the rail mill capacity of this district fully engaged in the rolling of rails.

Perhaps the most interesting rail transaction of the year was the purchase in February of 35,000 tons by the Illinois Central Railroad from the Algoma Steel Company at Sault Ste. Marie, Canada. Transpiring at a time when domestic mills were hungriest for business, and concluded on the basis of $27 per ton, at Chicago, or $3 per ton less than the local mill price, this transaction brought into bold relief the lack of tariff protection and created a country-wide sensation. In all, the Canadian mill sold approximately 60,000 tons of rails to domestic roads having advantageous delivery points along the border, and only the absorption of the Algoma mill's capacity in the manufacture of steel for war purposes brought an early ending to its efforts with our railroads.

The periods of car buying closely parallelled the periods of rail activity. In the first nine months of the year the number of cars bought was, with the possible exception of the plant at Michigan City, insufficient to keep the car builders more than moderately busy, and prices for cars approximated cost figures for practically all that were built. The fact that the car companies have been conspicuous among those engaged in the manufacture of war munitions is an indication of their inactivity in their own normal line. That the number of cars for which the railroads have been in the market in the last three months reached an unexpected total, appears in the fact that some of the car builders were forced to decline to quote for the reason that they found themselves unable to secure steel with which to build the cars, although having ample shop capacity. Under such circumstances the advance in the prices of cars was exceedingly rapid, the increase in some instances amounting to nearly 100 per cent. Although the railroads rebelled, conspicuously in the case of the Pennsylvania Railroad, which was in the market for 11,000 cars, their need, arising out of the tremendous increase in freight tonnage, particularly one-way freight from all parts of the country to the seaboard, compelled their acquiescence.

BARS AND SHAPES PRESENT A CONTRAST

Among the finished steel products, steel bars were so heavily sold for export and for the manufacture, in this country, of shrapnel that they disappeared from the market as an item of interest. Fortunately, the consideration of the annual implement contracts antedated the worst conditions, but even at that time the mills had sufficient bar business in sight to support them strongly in their stand for a limitation of the implement contracts to a term of six months instead of a year, as usual. As it has turned out, the contention of the mills in that regard has saved to them from $3 to $5 per ton, and possibly more, on many thousands of tons of bars.

The demand for structural material was notable for being so limited throughout the year. Except for car building and for a few large bridge contracts, including 24,000 tons at St. Louis, 16,000 tons at Paducah, over 20,000 tons at Kansas City and the 30,000 tons for track elevation at Indianapolis, structural steel tonnage, especially in the larger sizes of beams, has been sharply in contrast to other steel products. This is attributable to the very light building operations of the year, although plant extensions in recent months have occasioned demand for a considerable tonnage of shapes in smaller sizes.

PLATES COMPLETELY REVERSED THEIR POSITION

Plates and sheets presented two of the interesting phenomena which made up the unique experiences of the year. Until every form of finished steel products was rendered difficult to secure because of shortage of raw steel, plates, which ordinarily are sold at the same price as structural material and bars, were at least $1 per ton cheaper and frequently the object of even greater concessions. This was due, first, to a general lack of demand and, second, to the large number of mills rolling plates exclusively, which were forced to sell their product at such prices as they could obtain in order to keep running. For the same reason, when, in the last quarter, the mills making a varied line of products were using most of their ingot capacity for the rolling of products other than plates, the exclusive plate mills found themselves able to quote reasonable deliveries in a field of unusually limited competition and, as a result, plate prices, which had been under the market throughout most of the year began to command premiums in excess of any other commodity and even to the extent of $12 per ton.

SHEETS AND BARB WIRE

The experience with black and blue-annealed sheets was similar. The marketing of galvanized sheets, whose manufacture depended directly upon spelter, was utterly disorganized when the price of spelter, as a result of its exportation in unprecedented volume, jumped from 5c. per lb. to 27c. in the course of a few weeks. While some galvanized sheets have been sold by a few mills at all times during the year, the largest producers have been entirely out of the market for the greater part of the time. The price of No. 28 advanced from 2.70c. to a maximum of 5.25c., Pittsburgh, and the customary differentials between gages were entirely replaced by special quotations from time to time.

No better example of the influence of the war on the finished steel products from our mills can be had than is offered in the case of barb wire. The Chicago district normally produces wire to the amount of $32,000,000 annually, for use in one form or another, almost entirely in this country. But in the past year the exports of barb wire, running into hundreds of thousands of tons, have so far curtailed the amount available for the ordinary requirements of home consumption that prices have steadily advanced throughout the twelve months. From a price of $2.14 per 100 lb. at Chicago in December, 1915, successive advances have brought the quotation up to $3.14, or an increase of $20 per ton. This is the highest price recorded, and for rapidity of increment the values now prevailing have no parallel.

THE TRADE IN PIG IRON

With respect to pig iron and old material, the Chicago market was more tardy than any other in increasing its sales and elevating its prices. It is even now difficult to point out any other than general causes that finally inaugurated, in August, the occasionally almost panicky pig-iron buying of the last quarter. Once started, the demands of production brought into operation every idle furnace for which the necessary ore supply could be secured. And so greatly hampered was the rush for ore in the closing weeks of navigation, by the diversion of Lake carrying capacity to the more

profitable grain trade, that two stacks with an aggregate daily capacity of about 450 tons will be without ore for operation until navigation opens again.

Until August 1 the price of iron at Chicago furnace remained at $13. In the four months following the price rose to $18, but the activity of four months could not quite offset the stagnation and profitless prices of the preceding eight and the merchant pig-iron output at Chicago, which was typical of the entire district, fell just short in value of the 1914 sales, which amounted to about $8,100,000. But the furnaces enter the new year with their capacity for the entire first half of 1916 very largely sold at prices in which there is a profit.

PRICE FLUCTUATIONS IN LEADING BRANCHES

The following tables show the course of prices in the Chicago market in 1915, compiled from the weekly reports in THE IRON AGE:

Average Chicago Prices of Pig Iron

	Northern Coke No. 2	Lake Superior Charcoal	Southern Coke No. 2
January	$13.00	$15.75	$13.50
February	13.00	15.75	13.50
March	12.94	15.75	13.50
April	13.00	15.75	13.50
May	13.00	15.75	13.50
June	13.00	15.75	13.63
July	13.00	15.75	13.75
August	13.44	16.00	14.56
September	13.90	15.85	15.40
October	14.62	15.75	15.88
November	17.13	17.00	17.75
December	18.20	18.65	18.30
Average for year	$14.02	$16.10	$14.73
Average for 1914	$13.60	$15.60	$14.46
Average for 1913	15.95	16.50	16.12
Average for 1912	15.32	16.77	16.11
Average for 1911	14.87	16.96	14.80
Average for 1910	17.10	18.67	16.30
Average for 1909	17.49	19.50	17.30
Average for 1908	17.57	20.24	16.76
Average for 1907	24.50	26.56	24.47
Average for 1906	20.43	20.72	19.44
Average for 1905	17.65	17.99	16.66
Average for 1904	14.37	15.50	13.92
Average for 1903	19.25	22.13	18.31
Average for 1902	20.86	23.50	20.10
Average for 1901	15.38	17.50	14.60
Average for 1900	19.47	22.00	18.35

Average Chicago Base Prices of Finished Iron and Steel

	Common Bar Iron. Cents	Soft Steel Bars. Cents	Structural Steel. Cents
January	0.98	1.289	1.289
February	1.05	1.289	1.289
March	1.11	1.302	1.327
April	1.14	1.343	1.343
May	1.15	1.389	1.369
June	1.20	1.389	1.389
July	1.20	1.439	1.429
August	1.23	1.514	1.489
September	1.29	1.539	1.539
October	1.38	1.602	1.577
November	1.50	1.789	1.789
December	1.69	1.929	1.949
Average for year	1.24	1.484	1.482
Yearly Averages			
Average for 1914	$1.06	$1.32	$1.34
Average for 1913	1.43	1.55	1.60
Average for 1912	1.32	1.42	1.46
Average for 1911	1.22	1.47	1.50
Average for 1910	1.45	1.62	1.66
Average for 1909	1.43	1.50	1.59
Average for 1908	1.56	1.66	1.82
Average for 1907	1.78	1.77	1.87
Average for 1906	1.71	1.68	1.86
Average for 1905	1.65	1.65	1.78
Average for 1904	1.41	1.50	1.71
Average for 1903	1.65	1.72	1.75
Average for 1902	1.71	1.73	1.75
Average for 1901	1.58	1.58	1.70
Average for 1900	1.75	1.75	2.00

Average Chicago Prices of Old Material

	Cast Borings. Net ton	No. 1 Railroad Wrought. Net ton	Heavy Cast Scrap. Net ton	Heavy Melting Steel Scrap. Gross ton	Old Steel Rails, Rerolling. Gross ton
January	$4.63	$8.69	$9.19	$9.19	$9.63
February	4.75	8.88	9.00	9.56	9.88
March	4.75	9.00	9.00	9.63	10.25
April	4.80	8.65	9.00	9.15	10.25
May	5.00	8.94	9.00	9.38	10.25
June	5.00	9.00	9.00	9.44	10.25
July	5.15	9.15	9.25	10.40	10.30
August	5.75	10.44	9.63	11.56	12.25
September	6.40	11.00	10.10	11.75	13.35
October	6.50	11.19	10.50	11.75	13.31
November	6.56	12.94	12.13	13.44	14.44
December	7.55	15.38	13.75	15.63	16.63
Average for year	$5.57	$10.27	$ 9.96	$10.91	$11.73
Yearly Averages					
Average for 1914	$4.61	$8.66	$9.70	$9.37	$10.96
Average for 1913	5.36	10.80	10.44	10.90	13.33
Average for 1912	6.67	12.54	12.29	12.12	14.19
Average for 1911	5.34	11.23	11.08	10.92	12.91
Average for 1910	5.50	12.99	13.32	13.43	16.34
Average for 1909	6.37	13.76	13.79	14.45	15.82
Average for 1908	5.37	12.45	12.69	12.45	14.40
Average for 1907	8.78	14.63	17.26	15.08	17.53
Average for 1906	8.69	15.62	14.55	14.74	17.15
Average for 1905	8.57	16.14	13.50	13.97	15.02
Average for 1904	4.72	12.45	10.95	10.72	12.54
Average for 1903	7.33	16.07	14.75	15.50	19.04
Average for 1902	8.89	19.68	15.03	17.37	23.35
Average for 1901	4.20	15.00	11.25	12.84	16.05
Average for 1900	6.65	15.00	11.00	12.84	15.50

SCRAP MARKET FEATURES

In the scrap market the prices of almost every grade of old material have been predicated upon the demand for steel-making operations. In the latter part of the year the requirements of the Indiana Harbor mill, normally the most important consumer in the district, although unusually large, were overshadowed by the buying for consumption at Gary, and an advance of $2 per ton was recorded within a fortnight. Something of the speculative character given to the market is illustrated by a purchase, for resale, of 10,000 tons of heavy melting steel in the early fall at a price of $12.50, the market at the time being at a level approximately 75c. per ton less. The advance to a basis of $15 in November was ample to assure a handsome profit from the transaction.

In general, the heavier operations of Chicago plants in iron and steel lines were restricted to so small a portion of the year that, despite the rush which then developed, the value of output exceeded that of 1914 by a very small margin. The one exception was the production of rolled steel products which in 1914 were valued at approximately $77,250,000. In 1915 the value of finished steel materials rolled at Chicago mills totaled about $108,375,000. In the accompanying tables the average prices for each month of the year are given, and in their upward trend a most interesting and decidedly cheering part of the story of the greatest year in the Chicago iron trade is told.

FURTHER COMPARISON OF PRICES

Elsewhere in this issue of THE IRON AGE will be found comprehensive tables giving prices at Chicago of local No. 2 foundry pig iron, Lake Superior charcoal pig iron and leading varieties of old material, covering a long series of years. These tables have been given separately because of their length and also because the information thus given is of such importance as to justify special treatment.

Wire Rod Prices at Pittsburgh for Fifteen Years

Quotations on wire rods did not regularly appear in market reports until 1901. The table given below therefore represents the available figures as far back as public prices are concerned. They are for Bessemer wire rods, per gross ton, at Pittsburgh, averaged from weekly quotations in THE IRON AGE.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Jan.		$33.45	$34.70	$30.00	$31.00	$33.75	$37.00	$34.30	$33.00	$33.00	$28.00	$24.37½	$30.00	$25.50	$25.00
Feb.		35.00	35.75	30.00	31.00	34.00	37.00	35.00	33.00	33.00	28.75	25.00	30.00	26.28	25.00
March		35.50	36.62½	30.80	31.70	34.00	37.00	35.00	33.00	33.00	29.00	25.00	30.00	26.50	25.00
April		36.00	37.00	31.00	34.00	34.12½	37.00	35.00	29.00	32.50	29.00	25.00	30.00	26.00	25.00
May		36.80	37.00	30.50	34.00	34.40	37.00	35.00	27.50	32.00	29.00	25.00	30.00	25.50	25.00
June		37.00	36.62½	29.20	33.30	34.00	37.12½	33.50	27.50	30.80	28.25	25.00	29.50	24.50	25.00
July		36.00	35.80	28.00	31.87½	34.00	36.50	33.00	29.40	29.25	27.00	25.00	28.30	24.50	25.63
Aug		36.00	35.00	28.00	32.10	34.00	36.10	33.25	31.00	28.25	27.00	25.80	28.00	25.00	27.00
Sept		35.87½	34.75	27.00	31.12½	34.00	36.00	33.00	31.50	28.00	27.00	27.00	27.37½	26.20	29.40
Oct	$32.75	35.90	34.00	26.00	31.75	34.50	35.40	33.00	31.87½	28.50	26.00	28.50	26.60	25.88	31.75
Nov	33.00	35.50	31.62½	26.75	32.10	35.50	34.00	33.00	32.50	28.12½	25.30	29.75	25.87½	25.25	36.25
Dec	32.62½	34.50	30.50	29.80	32.50	37.00	34.00	33.00	33.00	28.00	24.50	30.00	25.17	25.00	39.50

The Pittsburgh Iron Trade in 1915

BY ROBERT A. WALKER

A greater contrast in the condition of the Pittsburgh iron trade at the opening and the close of 1915 could hardly be conceived. Starting with many mills idle for want of orders, the spring months began to show betterment, and from that time there was a rise in both demand and prices for steel products, becoming so rapid in the last half of the year that makers were swamped with business and prices reached a very profitable basis. In all of 1914 buying of steel products, especially by the railroads, was much under normal, and few large new projects were undertaken. The whole country needed steel badly, but consumers did not have the confidence to buy it. The railroads could not borrow money except at ruinous rates of interest, and their abstention from buying cars, locomotives, rails and general track materials seriously affected the iron and steel industry. With the opening up of a foreign demand for rails, cars and war munitions in the spring, and a great increase in the supply of money for investment, conditions quickly changed and there was a steady increase in mill operations.

While much of the improvement in the steel trade was due to war orders it was more largely due, in the second half of the year, to a great increase in domestic business, featured by heavy buying by railroads of steel rails, track materials, rolling stock and general supplies. The extension of blast-furnace and steelworks capacity in the first half of 1915 was practically nothing, but with the wonderful increase in demand in the last half steel manufacturers hastened to increase their facilities so as to handle more of the business constantly being offered. There were no important failures in the steel trade in 1915, and labor was never better employed than at its close.

The outlook for 1916 is excellent, but it is generally realized that if peace should be declared a readjustment would have to take place and this would likely, for the time at least, adversely affect the situation. It is believed, however, that the present active rate of operations and high prices is practically assured for the first half of the year.

THE COURSE OF THE PIG-IRON TRADE

Prices of all kinds of pig iron continued low in the first half of 1915. In the latter half of the year they advanced rapidly, and 1915 closed with makers realizing an advance of $5 to $5.50 per ton over their January sales. As showing the extraordinary increase in the demand for pig iron, it may be mentioned that in January the Carnegie Steel Company was operating only 22 or 23 blast furnaces out of a total of 59, whereas at the close of the year 53 were active and its Edith and Neville Island stacks, which have been idle for several years, were being prepared for early resumption of production. Again, in the Mahoning and Shenango valleys, in January, only five stacks were active, but at the close of the year every furnace in the two valleys was in operation except two, one of which was being relined and repaired, and the other had been rendered inoperative by an accident.

No new furnaces were built in the Pittsburgh or Valley districts in 1915, but in November the Republic Iron & Steel Company announced that it would build a new blast furnace, and in December the Youngstown Sheet & Tube Company stated that it would also erect a new stack. The Carnegie Steel Company is completely rebuilding one of its furnaces at Bellaire, Ohio, and in 1915 the Andrews & Hitchcock Iron Company rebuilt one of its furnaces, making it practically a new stack.

The following table gives the monthly prices in 1915, averaged from weekly reports in THE IRON AGE, of Bessemer, basic, No. 2 foundry and gray forge iron, at Valley furnace, to which 95 cents per ton should be added for delivery in the Pittsburgh district:

Average Monthly Pig-Iron Prices, f.o.b. Valley Furnace—Per Gross Ton

Month	Bessemer	Basic	No. 2 Foundry	Gray Forge
January	$13.61	$12.50	$13.00	$12.50
February	13.50	12.50	13.00	12.50
March	13.50	12.50	13.00	12.50
April	13.50	12.50	12.75	12.50
May	13.61	12.50	12.94	12.50
June	13.75	12.57	12.69	12.45
July	13.95	12.86	12.70	12.53
August	15.00	13.87	13.62	13.06
September	15.90	14.75	14.70	13.70
October	16.00	15.00	14.87	13.75
November	16.56	15.75	15.50	14.75
December	18.80	17.60	18.30	17.10

STEEL BILLETS

In the first three or four months of 1915 the demand for steel billets was light and prices showed little improvement on 1914. In January both Bessemer and open-hearth billets were to be had at about $19, Pittsburgh. In the last six months of the year the billet trade was phenomenally active and prices advanced rapidly, until in December as high as $35 had been paid for open-hearth billets, and they could hardly be had at any price. There was also a famine in the supply of Bessemer billets, and mills that could make reasonably prompt deliveries were able to secure almost any prices asked. Forging billets, from January to December, advanced about $30 per ton, an unprecedented record.

In the Pittsburgh district only minor additions were made to steel producing capacity in 1915, but in the Youngstown district the Youngstown Iron & Steel Company completed its new open-hearth steel plant, containing three 80-ton furnaces; the Republic Iron & Steel Company completed two 80-ton furnaces; the Brier Hill Steel Company completed one 90-ton furnace, and is building two more; the Youngstown Sheet & Tube Company is to add three more 80-ton furnaces.

STEEL RAILS

The year 1915 was the best that the Pittsburgh steel-rail mills have experienced for a long time. This was due partly to heavy export orders and partly to the great increase in the demand for rails from domestic railroads in the last half of the year. The Edgar Thomson three rail mills of the Carnegie Steel Company works were operated to full capacity in the last half of 1915, one mill turning out light rails, one rolling large steel rounds nearly exclusively and the third making standard sections. Improvements in the Edgar Thomson works have recently been completed, including a mill which can roll rails up to 150 lb. per yard. The demand for light rails in the last half of the year was extremely heavy, and several advances in prices were made. The price of standard section Bessemer rails was held steadily through the year at 1.25c. and of open-hearth rails, 1.34c., Pittsburgh.

STRUCTURAL MATERIAL

The demand for structural steel shapes in the first three or four months of 1915 was dull, but in May it began to increase, thence growing rapidly, the close of the year finding fabricating concerns filled for four to six months ahead and not actively bidding on new work. The year opened with beams and channels up to 15-in. selling at about 1.10c., Pittsburgh, while at the close of the year the price was 1.80c. for extended delivery, but up to 2c. and 2.25c. was being paid for small lots for prompt shipment.

STEEL PLATES

Steel plates were in but moderate demand for the first four or five months of 1915. In the last six months trade became extremely active, the close of the year finding the large plate mills sold up for months ahead, and premiums of $2 to $5 per ton being

paid for prompt deliveries. In the last half of the year the steel-car companies, having booked large orders for steel cars, were heavy users of plates, while the shipbuilding companies were loaded with orders for boats, making their requirements of plates unusually large. At the beginning of the year, plates were selling at about 1.05c. to 1.10c., Pittsburgh, and at the close the minimum price was 1.80c. to 1.90c. for such deliveries as the mills could make at their convenience, premiums of $5 to $8 per ton being paid for reasonably prompt shipment. There were no additions to plate mill capacity in the Pittsburgh or Valley district during the year, but it is probable that in 1916 at least one large new plate mill will be built in the Pittsburgh district.

WROUGHT IRON AND STEEL PIPE

Tubular goods in the first three or four months were not in strong demand and prices were low. In the last half of the year the consumption grew rapidly, and 1915 closed with both steel and wrought-iron pipe mills running close to capacity. The demand for boiler and merchant tubes and seamless steel tubing in the last half of the year was heavy. The two local makers of seamless steel tubing were practicallly out of the market in December, having their entire output sold up for six months at least. Galvanized iron and steel pipe rose at one time $10 per ton, owing to the high cost of spelter, and prices on black iron and steel merchant pipe were advanced several times in the last half of the year. There were also advances on boiler and merchant tubes, the last one, of $2 per ton on both steel and iron tubes, having been made Dec. 1. The outlook for the pipe and tube trade for the first half of the new year is regarded as most excellent.

THE COURSE OF THE COKE TRADE

In the first four or five months of 1915 the demand for coke was much below normal. Many blast furnaces were idle, thus cutting down the consumption of furnace coke, and numerous foundries were either entirely idle or running only part time, diminishing the consumption of foundry coke. At the opening of the year best grades of furnace coke were selling for prompt shipment at $1.40 to $1.50 per net ton at oven and on contracts at about $1.75, while prompt 72-hr. foundry coke was selling at about $2 and contract $2.15. At that time the output of coke in the upper and lower Connellsville regions was only a little over 200,000 net tons per week, or slightly more than half the oven capacity. Toward the close of the year there was a flurry in the price of prompt furnace coke, due mainly to shortage of cars, and it sold as high as $3.50 per net ton at oven, while best grades on contracts for first half of 1916 were firm at $2.50. Best grades of 72-hr. foundry coke for prompt shipment were held at $3 and higher, and on contracts $3.25 to $3.50.

The following table shows monthly prices per net ton at oven on prompt and contract furnace and foundry coke during 1915, averaged from weekly prices in THE IRON AGE market report:

Prices at Oven of Connellsville Coke in 1915—Per Net Ton

Month	Prompt Furnace Coke	Contract Furnace Coke	Prompt Foundry Coke	Contract Foundry Coke
January	$1.50	$1.70	$2.00	$2.15
February	1.50	1.65	2.00	2.15
March	1.50	1.65	2.00	2.15
April	1.50	1.65	2.00	2.15
May	1.50	1.65	2.00	2.15
June	1.56	1.70	2.00	2.21
July	1.64	1.77	2.05	2.27
August	1.50	1.75	2.00	2.25
September	1.61	1.95	2.07	2.34
October	2.03	2.28	2.35	2.61
November	2.28	2.44	2.88	2.94
December	2.64	2.40	2.95	3.00

While the outlook for the first half of 1916 is regarded with confidence by makers, it is likely that the consumption of bee-hive furnace coke in the last half of the year will fall off. The Youngstown Sheet & Tube Company and the LaBelle Iron Works, both important coke consumers, will have their new by-product coke plants going about April or May, and will then be out of the market as buyers of furnace coke. Also it is announced that the Brier Hill Steel Company will soon start the construction of a by-product coke plant. On account of the large number of by-product ovens beginning production in the coming four or five months, prices of furnace coke for the last half of the year have for some time been quoted lower than for delivery in the first half.

OLD MATERIAL

Only a fair amount of activity characterized the old material trade in the first half of the year, but in the last half it became quite active. Early in January selected heavy steel scrap was selling at about $11.50 per ton, Pittsburgh, and when the year closed it was selling at about $17.50, an advance of about $6. As steel works everywhere were running at maximum capacity in the last four or five months, the demand for scrap was heavy. The year closed with prices firm and prospects bright for the early part of 1916. The following table shows monthly prices on the grades of scrap noted, averaged from weekly market reports in THE IRON AGE:

Old Material Prices, Pittsburgh, 1915—Per Gross Ton

Month	Heavy Steel Scrap	No. 1 Foundry Cast	Bundled Sheet Scrap	Re-rolling Rails	Cast-Iron Borings	Machine-Shop Turnings
January	$11.62	$11.25	$9.19	$11.75	$8.19	$7.69
February	11.62	11.25	9.25	11.75	7.94	7.81
March	12.00	11.44	9.25	11.75	8.06	7.62
April	11.85	11.90	9.15	11.65	8.25	7.85
May	11.75	12.00	9.25	11.62	8.25	7.75
June	11.75	12.12	9.50	11.75	8.44	7.94
July	12.10	12.15	9.50	11.75	8.70	7.95
August	13.81	12.62	11.06	13.62	9.19	8.25
September	14.30	15.00	11.80	14.25	9.40	8.65
October	14.31	13.06	12.25	14.37	9.31	8.37
November	15.87	13.75	12.19	15.12	9.69	8.62
December	17.45	15.15	13.15	17.40	10.50	9.55

The Philadelphia Iron Trade in 1915

BY CHARLES LUNDBERG

Conditions in late 1915 were so unprecedented that comparisons seem futile. Taken as a whole, the year was not what is usually termed a good one. Yet it witnessed a most wonderful transition from a dull, dragging market to one of overwhelming demand, of soaring prices; from a market that was all in the buyers' hands to one where the sellers could dictate. None would have dared to prophesy all that has happened in the iron and steel trade, any more than he would have dared to predict the coming of the European war. A year ago none would have dreamed that salesmen would have been sent out to ask their customers to minimize their specifications, or that orders would be turned away.

In the first few months of the year advances in the quotations for plates, shapes and steel bars tended to anticipate demand rather than follow it. During this period manufacturers were eager for export business, despite the difficulties that faced them in the paucity of ocean freight space. Later, when domestic demand began to grow, less solicitude was felt for the foreign trade, largely due to the fact that many European buyers asked that quotations include the freight to their country, something which the frequent advances in ocean freight rates made almost impossible.

While domestic demand increased steadily in the first six months of the year, it was not until about the end of June that a widespread waking up of industrial demand became apparent. It was manifested by the effort of consumers to get under cover at the

then prevailing prices, which, on plates, shapes and steel bars, were about 1.359c., Philadelphia, or 1.20c., Pittsburgh. The purchase by the United States Steel Corporation of 15,000 tons of billets from an eastern Pennsylvania mill, about July 1, signalized the forthcoming pressure. In the latter part of August, one mill after another practically retired from the market. With buyers eager to pay premiums for desired deliveries, great irregularity in prices resulted. Some mills, with the avowed purpose of reducing their booked tonnage, announced what they considered prohibitive quotations, but still the orders appeared. That the facilities for making steel were inadequate became evident on every side and practically every mill set about increasing its open-hearth capacity.

IRON ORE

The year was a lean one for those engaged in the foreign ore trade. At no time was any great interest shown by consumers in foreign ore, and toward the end of the year new contracts called for Lake Superior and Eastern ores instead of those from other lands. Early in the year ocean freights advanced to a point which forecast reliance on domestic ores. Ship owners found it more profitable to rush their boats back from Europe, in ballast if needs be, rather than delay their return to take on coal and ore. Late in the year the high price of low phosphorus iron caused iron makers to cast around for low phosphorus ore. In early November about 70,000 tons of Spanish and Cuban ore for 1916 delivery was purchased by an eastern Pennsylvania maker of low phosphorus iron. Later in November 18,000 tons of Spanish low phosphorus ore was bought for 1916 delivery by the Worth Department of the Midvale Steel & Ordnance Company. In May a small quantity of Canadian ore came to this market. Arrivals of foreign ores at this port in 1915 aggregated 280,355 tons from Cuba, 153,650 tons from Chile, 207,991 tons from Sweden, 29,241 tons from Spain, 738 tons from France, 2638 tons from Egypt, 7380 tons from Canada, and 5100 tons from French Africa, a total of 687,093 tons. A large part of the deliveries from Sweden, Cuba and Chile was for the Bethlehem Steel Company. In 1914 about 800,000 tons was brought here, of which about 315,000 tons was Cuban, 40,000 Chilean and 286,000 Swedish.

PIG IRON

As compared with the demand for steel, that for pig iron was a laggard. In fact, it was not until October that foundry iron began to gather headway for the rush that came in the last quarter of the year. Steel-making iron had moved more in accordance with the demand for steel. Most noteworthy was the demand for low phosphorus, the quotation for which, delivered in this district, advanced $12 per ton in the year; the end of 1915 finding its producers sold up for months to come, and the price $32, delivered. Foreign inquiries for low phosphorus were numerous from the early part of the year to the last, and considerable was exported. At intervals heavy tonnages of basic were taken by an eastern Pennsylvania plate mill, among the purchases being 47,000 tons in April, 40,000 in June, 35,000 in August, 45,000 in September and 58,000 in October.

In December, 1914, there were only 12 furnaces in blast in the district under the jurisdiction of the Eastern Pig Iron Association, whereas last month there were 22. The aggregate stocks of iron on furnace banks was approximately the same Dec. 1, 1914, and Dec. 1, 1915. From Dec. 1, 1914, to Jan. 1, 1915, furnace stocks increased considerably, but the January stocks are almost always higher than those of December because of the curtailment of shipments toward the end of the year when consumers wish to have their stock as low as possible for inventory purposes. In December of both years stocks were not much in excess of the quantities required of the various grades which it is necessary to carry to fill current orders. Virginia producers were in a tight position toward the end of the year, one being out of the market entirely, another having no No. 2 X to offer, and all advancing their quotations to equal those of eastern Pennsylvania iron. In early December the quotations for No. 2 X foundry and Virginia No. 2 X touched $20, delivered in or near Philadelphia. Orders for Virginia iron increased until in December their volume was almost nine times what it was in January. Stocks were larger at the end of the year, but, whereas their total Jan. 1, 1915, was three times the aggregate of orders, at the end of December the orders amounted to twice the stocks. The accompanying table shows the monthly averages of minimum weekly quotations in THE IRON AGE for the principal grades of pig iron delivered in buyers' yards, eastern Pensylvania and nearby points.

Average Prices of Pig Iron, Prompt Delivery in Buyers' Yards, Eastern Pennsylvania and Nearby Points, in 1915

	Penna. No. 2 X	Virginia No. 2 X	Standard Gray Forge	Standard Basic	Standard Low Phos.
January	$14.25	$15.25	$13.50	$13.50	$20.00
February	14.25	15.25	13.44	13.50	20.00
March	14.25	15.25	13.25	13.50	20.00
April	14.25	15.25	13.25	13.31	20.00
May	14.25	15.25	13.25	13.25	20.00
June	14.25	15.25	13.25	13.45	20.60
July	14.31	15.25	13.25	13.94	21.38
August	15.05	15.40	14.50	15.35	22.25
September	16.13	16.00	15.13	17.00	24.50
October	16.25	16.31	15.25	17.00	26.25
November	17.35	17.80	16.05	17.35	29.40
December	19.19	19.13	17.63	18.25	32.00

BILLETS

In no direction did the year bring greater change than in billets. Open-hearth rerolling billets in January were quoted at $21.40 and forging billets at $25.40. In December, the first-named were unobtainable for prompt delivery from Eastern makers, while for second quarter delivery $40 was asked and obtained. Forging billets sold at $55, for the same delivery. In August the demand became so great that makers who ordinarily sold their surplus began to take heed of conserving their supply to care for the equally great demand for their finished products. The export demand became heavy as soon as Europe began to experience the inadequacy of its supply, and at no time was the foreign demand satisfied. Early in the year more would have been done with foreign consumers had it not been for the shortage of ocean freight space. In July prices began to advance sharply with the realization that the supply of crude steel would fall far short of the demand.

FINISHED STEEL PRODUCTS

Plates were among the weakest of finished steel products in the first few months of the year, though from March 1 they slowly gathered strength. The Philadelphia quotation advanced $1 per ton to 1.309c., March 1, and there was a like advance April 1, after which the market became easier at 1.309c. Late in June, however, the price again became fixed at 1.359c., advanced to 1.409c. in July, to 1.459c. in early August, and to 1.509c. in late August. Subsequently there were one or more advances of $1 per ton each month, until 1.809c. was reached in November. In this month Eastern mills became so crowded with specifications and new orders that their quotation on current business rose to 2.159c., and in December to 2.409c., Philadelphia, and this latter price was quoted to favored customers only. Outsiders were asked from 2.659c. upward.

As in plates, structural shapes in the first two months of the year were quoted at 1.10c., Pittsburgh, or 1.25c., Philadelphia. Here also on March 1 the quotation advanced $1 per ton to 1.309c., Philadelphia. In the first half of the year the market was quiet as a rule, but the mills began to fill up rapidly in August, and thereafter price advances began to be frequent. In October producers were practically filled up. Demand from the West and South became heavy and, contrary to custom, quotations were based on Eastern mill prices. Two such quotations, at the beginning of November, were 1.75c. and 1.80c., eastern Pennsylvania mill. Later in the same month 1.85c., also Eastern mill, was quoted. In December the quotation on current deliveries rose to 2.159c., Philadelphia, and to 2.25c., Eastern mill, on Western and Southern business. Of importance in the year was the advance in freight rates, which in February added 0.9c. per 100 lb. to the freight (then 15c. per 100 lb.) on finished iron and steel products from Pittsburgh to Philadelphia.

Steel bars were quoted in January at 1.10c., Pitts-

burgh, or 1.25c., Philadelphia. The course of prices was much the same as in plates and shapes, and the end of the year found some producers not quoting, and the obtainable quotations high and irregular. In their extremity consumers of steel bars turned to iron bars, but to little avail so far as price was concerned, inasmuch as the quotations of the latter kept pace with those for steel bars. The mills that could and did turn their attention to shrapnel rounds quickly filled up on such business, and one mill refused a large order in November which was offered at 3.75c.

Blue annealed sheets, quiet during a large part of the year, were in heavy demand in the last few months. No. 10 sheets were quoted at 1.45c., Philadelphia, in early January, and the price stood at about that level until July, when demand began to become lively. From that time on the market was strong, and about the middle of December the quotation was 2.559c., Philadelphia.

OLD MATERIAL

In a broad way the scrap situation of 1915 is summed up in the statement that prices were low because of the surplus of accumulated material, which was disposed of slowly. The end of the year found the large stocks reduced to a considerable extent, although not altogether, and, as a result, prices began to reach values relative to those which prevailed for pig iron, steel and other products. Heavy melting steel was quoted early in January at $10, and the general trend of prices was upward until $16 was reached in December. The end of the year found low phosphorus scrap, railroad wrought and wrought-iron pipe especially strong. Old steel axles, late in 1915, were in heavy demand for export and commanded high prices. Average prices for a long series of years are tabulated elsewhere. The monthly prices for 1915, on commodities not included in that table, averaged from weekly quotations in THE IRON AGE, are given herewith:

Average Prices of Low Phosphorus Steel, Iron Rails, Wrought-Iron Pipe, Stove Plate and Railroad Malleable Scrap, Delivered In Buyers' Yards, Eastern Pennsylvania, in 1915, per Gross Ton

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average, 1915	Average, 1914	Average, 1913
Low phos. steel	$14.00	$14.00	$14.25	$14.25	$14.44	$14.65	$15.06	$16.60	$20.13	$20.25	$20.00	$21.13	$16.56	$10.38	$11.97
Iron rails	13.00	13.00	13.00	13.50	14.88	15.00	15.25	16.40	18.50	18.00	17.50	19.25	15.61	14.75	17.56
Wrought-iron pipe	9.69	10.00	10.00	10.00	10.63	10.75	10.88	12.75	14.13	13.25	13.50	14.88	11.71	7.96	11.39
Stove plate	8.38	8.50	8.70	8.75	9.00	9.00	9.38	10.30	10.50	10.50	10.60	12.13	9.65	8.69	9.86
Railroad malleable	9.00	9.00	9.00	9.00	9.50	9.50	9.94	10.30	10.50	10.50	10.60	14.40	10.10	9.17	11.85

The Cincinnati Iron Trade in 1915

BY CHARLES L. SMITH

A particularly prominent feature of the market in 1915 was the sensational advance in high silicon irons, which occurred mainly in the last quarter of the year. Quotations on 8 per cent Ohio silvery irons on Dec. 1, 1915, were fully $10 per ton higher than on Dec. 1, 1914. Another very important matter is the increase in the consumption of basic iron in this territory. It would be difficult at present to contract for any steel-making iron for prompt shipment. This condition is exactly the reverse of that existing a year ago. At the close of 1914 the southern Ohio furnaces were eager for business at $12.75 at furnace, but at this time they are quite indifferent about taking basic or malleable business at $18, and then only for shipment at their convenience before July 1, 1916. Southern foundry iron prices also show quite a wide range from January to December of the past year. To be exact, the difference between the quotations of the two months named is $4.50 to $5 per ton.

REVIEW OF THE FIRST QUARTER

The month of January was somewhat dull. Few inquiries came out in the first two weeks. Some sales of low grade Southern iron were made, but the usual differential of 50c. per ton was not generally observed, as sellers were able to obtain a price within 25c. per ton on No. 3 foundry as compared with No. 2. Toward the end of the month there was some activity in high silicon irons and a few sales were made at $15 at furnace, based on an 8 per cent analysis.

Southern No. 2 foundry iron was still obtainable at $9.50, Birmingham, for the entire month of February. An Indiana melter bought the first part of the month 4000 tons of mixed Northern and Southern foundry iron with shipments extending into the last half. The local jobbing foundries making a specialty of machine-tool castings received enough business to enable them to operate to full capacity, thus increasing the foundry melt considerably, but the stove makers were only using a comparatively small quantity of iron. An effort to advance Southern prices the latter part of the month was only partially successful, although some business was booked at $9.75, Birmingham. The larger buyers quietly came into the market the last week in February and the first part of March and considerable Northern foundry and malleable was bought at $12.75, Ironton, for nearby shipment, although it is understood contracts were made for delivery through the entire first half at the same figure.

About March 15 prices began to soften and both Northern and Southern irons were quoted from 25c. to 50c. per ton off. The inquiry was very backward and order books made a poor showing for a period that extended well into April. The weakening of Southern prices especially was attributed, in a large measure, to the dumping on the market of a quantity of foundry iron from a bankrupt furnace company's accumulations in Tennessee.

REVIEW OF THE SECOND QUARTER

An effort by Southern producers to establish a minimum of $9.50, Birmingham, was successful the second week in April, although some iron was sold that week at $9.25, with shipments extending through the second quarter. Local business showed some improvement and several round lots of both Northern and Southern foundry iron were bought by nearby consumers. The American Rolling Mill Company, Middletown, Ohio, also placed a contract for 35,000 tons of basic iron for last half movement. The bulk of this tonnage went to a furnace at Columbus, Ohio.

In spite of the keen competition for business by different selling agencies who held a considerable quantity of resale iron, the price of $9.50, Birmingham, was well maintained throughout the month of May. However, Northern iron weakened a little and many small contracts were taken on a basis of $12.50, Ironton. The demand for Ohio high silicon and for malleable irons improved considerably, although no advances in prices for either were noted in May or June.

In June the principal encouraging feature was the large tonnage of iron that was being taken by consumers, most of which was melted practically as fast as received, so that yard stocks were kept stationary. The only business of note received was from Indiana and Michigan territory. Southern iron was still obtainable at $9.50, Birmingham, on June 30.

REVIEW OF THE THIRD QUARTER

The first half of July was simply a repetition of conditions existing the previous month. Although other basic users in this territory came into the mar-

ket with inquiries for a future supply, no sales were reported. Changes in the Southern iron situation the last week of the month were so sudden as to be somewhat startling. Several large lots of Southern foundry iron were bought by different interests for speculative purposes, thus taking this iron off the market temporarily. The Ohio high silicon irons took a jump to $16, furnace. Virginia furnaces then invaded this territory and took orders for foundry iron about 25c. per ton lower than the Hanging Rock furnaces could sell at many different points. This was said to be the first time in several years that the Virginia producers had been able to compete with southern Ohio furnaces to any large extent.

Prices advanced rapidly in August. Heavy inquiries came out for foundry and basic, and some large contracts for the latter were made in this territory, all for shipment during the last half. The bulk of basic iron sold was by Hanging Rock and Columbus producers, but some of the business went to the Lake furnaces. A local melter bought 6000 tons of mixed Northern and Southern foundry iron and both Michigan and Indiana users contracted somewhat heavily. The second week in August Southern iron was quoted at $11, Birmingham, and Northern at $14, Ironton, which prices ruled the remainder of the month. High silicon irons also advanced 50c. per ton. For shipment during the first half of 1916 Southern producers were holding for $12 to $12.50.

A number of price changes were made in September, both Southern and Northern iron, for prompt shipment, being advanced 50c. per ton. Although some business for first half 1916 shipment had previously been taken by the Southern furnaces, they were reluctant to open their books formally, preferring to confine sales for delivery in 1915. Some resale iron at $11 appeared early in the month, but at the wind-up nothing below $11.50 could be done for prompt shipment, and very little was available at this figure. Both malleable and basic for 1915 shipment were very scarce and no appreciable tonnage could be obtained in the southern Ohio district.

REVIEW OF THE FOURTH QUARTER

October and November were months full of surprises, and the total tonnage bought quietly was far beyond the expectations of iron merchants. The nearby basic consumers were understood to have covered for full first half requirements, and one user was reported to have bought sufficient iron to keep operating through the third quarter of 1916. Steady advances were made in Southern foundry iron in October and at the close of the month it was quoted at $12.50, Birmingham, although some resale iron could have been bought at $12. The Ohio high silicon irons made two advances in that month, running up to $19, furnace, and in the second week of November quotations ranged from $23 to $24. Both Northern and Southern iron registered advances in November, and Cincinnati quotations were $17.76 and $16.40 respectively for No. 2. Michigan melters probably bought more foundry and malleable iron than those in other nearby districts.

Business was a trifle slow the first week in December, but a number of quiet sales were made the second week. Numerous tentative inquiries came out for foundry iron for last half shipment, but furnace interests were not willing to take on business for that delivery. Quite a large tonnage of malleable was sold to different consumers in Ohio, Indiana and Michigan.

LABOR TROUBLES

The latter part of the year the foundry melt in this immediate vicinity was below the monthly average up to July 1. In July several of the foundries at Hamilton, Ohio, experienced labor troubles, and a few of them closed down, and are now only operating at curtailed capacity. Strikes in Hamilton machine shops later on also cut down the demand for castings from that source. During the last four months of the year labor conditions in a large number of Cincinnati machine-tool plants were unsettled, and also this naturally reflected on the activities of many local foundries. The trouble seems now to be at an end and the melt in jobbing foundries is increasing, while the stove makers are probably consuming fully 25 per cent more iron than they were in December, 1914.

ACTUAL INVOICED PRICES AT CINCINNATI

The subjoined statement is prepared from the records of a prominent local pig-iron house and represents the average invoiced price of No. 2 foundry pig iron, Birmingham basis, for 11 months up to Dec. 1. It will be noted that the averages in February and March were higher than they were in January and April, the preceding and following months. It is stated that this was due to the sale of considerable iron for prompt movement in the first two named months, which went at a higher level than iron that was contracted for before the close of the year 1914.

Actual Prices of Southern No. 2 Foundry Iron Based on Shipments

1915		1915	
January	$9.982	July	$9.82
February	10.065	August	9.853
March	10.015	September	9.911
April	9.957	October	10.24
May	9.8661	November	10.321
June	9.80		

FLUCTUATIONS IN CINCINNATI PRICES

The following table shows the range of prices at Cincinnati on leading grades of pig iron and scrap, averaged from weekly quotations in THE IRON AGE:

Prices of Pig Iron and Scrap at Cincinnati in 1915

	Southern No. 2, Gross Ton	Northern No. 2, Gross Ton	No. 1 Railroad Wrought, Net Ton	No. 1, Machinery Cast, Net Ton
January	$12.40	$14.01	$7.62½	$9.87½
February	12.40	14.01	7.50	9.75
March	12.27½	14.01	8.50	10.25
April	12.30	13.96	8.50	10.25
May	12.40	13.76	8.50	10.25
June	12.40	13.76	8.50	10.25
July	12.55	13.86	8.75	10.55
August	13.71¼	15.07¼	9.31¼	11.06¼
September	14.15	15.46	9.50	11.50
October	14.77½	16.07¼	9.62½	11.62½
November	16.15	17.51	10.31¼	12.31¼
December	17.10	18.66	12.25	13.25

The market on old material was exceedingly dull the first quarter of the year and only began to pick up in April. Small price advances were made in April, but quotations were stationary during May and June. Small advances were also made in July, August and September, but it was well along in October before prices were marked up to any appreciable extent. This was due in part to the large demand from the Ohio mills, but a better demand also came from the stove manufacturers. In November, as well as in the first half of December, the total advances on all grades were $2 to $3 per ton. At the present time yard stocks are said to be diminishing.

Railroad Building in 1915

Less miles of new railroad were built in the United States in 1915 than in any other year since 1864, according to the *Railway Age Gazette*. There have been only three other years since 1848 when the increase was less than 1000 miles and they were the Civil War years of 1861, 1862 and 1864.

In 1915 the total mileage of new railroad constructed in the United States was 933, as compared with 1532 in 1914 and 3071 in 1913. There was also a large reduction in the mileage of second track built. In addition to the new line there were built 356 miles of second track, as compared with 565 miles in 1914, and 1264 in 1913, and 65 miles of third track, fourth or other multiple track, making a total of 1354 miles of track, as compared with 2127 in 1914 and 4466 in 1913. The largest mileage in one State was in Pennsylvania, which heads the list with 98 miles. Oregon was second with 83 miles and Washington third with 71 miles. None was built in 11 States. Canadian roads built 718 miles of new first track, as compared with 1978 in 1914. In Mexico 36.5 miles of new line was built as against none reported for 1914.

In the United States the reports received by the *Railway Age Gazette* show 2062 miles of new line projected, 1624 under survey and 1207 under construction.

The Sheet and Tin-Plate Trades in 1915

BY B. E. V. LUTY

The sheet and tin-plate trades were subject to some unusual vicissitudes in 1915. Committed to a fixed price for the season, the tin-plate mills were unable to secure advances such as occurred on most finished steel prices, except on a relatively small tonnage. The sheet industry suffered very severely from the extremely high prices of spelter, which injured the industry in twofold manner, sharply curtailing the trade in galvanized sheets and greatly increasing the competition in black sheets, through the extra productive sheet-mill capacity thus released. The sheet and tin mills certainly did not experience as large an increase in profits from 1914 to 1915 as obtained in the case of most producers and finishers of steel. However, it is possible their profits in 1914 did not drop to altogether as low an ebb as was the case with some other manufacturers, for the year had not been a bad one in tin plate, and in the case of the sheet mills the first half of the year had constituted a moderately profitable period.

REDUCTIONS IN SHEET-MILL WAGES

An important development of the unsatisfactory condition of the sheet trade was the disposition of manufacturers to break away from the domination of the Amalgamated Association and in February several of them abrogated their wages agreements and made reductions of 10 to 15 per cent, which were accepted by their men. Other manufacturers, desirous of avoiding the possibility of labor troubles, negotiated with the Amalgamated Association for a similar reduction. The members of that association, urged by their officers, took three referendum votes on the question, the first two of which were unfavorable, but the third, on March 27, resulted in a majority in favor of accepting the reduction.

SPELTER DISTURBS CONDITIONS

Spelter opened the year 1915 at 5.55c., East St. Louis, a price which consumers regarded as fairly high, since the market had dropped as low as 4.80c. just before the European war, and touched a still lower lever, 4.60c., in October. In view of this circumstance the majority of buyers had no confidence in a spelter advance based on war demand. As spelter advanced fractionally during January and February they refused to buy except for immediate needs. In March a level of 14c. was reached, this being followed by a sharp break, but June brought a fresh high point of 27c., the highest level of the year.

The unfortunate part of the matter for the sheet galvanizers was that they had done something that is done very commonly, though frequently with disastrous consequences—they had sold something they did not have. Indeed, they had really done worse than that, as they had given buyers the option of calling for the material or not. The buyers called for the galvanized sheets. When the spelter market reached the level at which the contracts began to show a loss, instead of limiting their loss by buying spelter the sheet galvaanizers played for time, and as a result some of them lost very heavily, the total loss in dollars probably running into seven figures.

Market prices for galvanized sheets were, of course, marked up, but buyers did not then take hold to any extent. After the contracts were filled galvanizing operations were light, say, from 25 to 35 per cent of capacity during July and August, increasing to about 50 per cent in the closing months of the year. As the year opened with some galvanized sheet contracts at 2.80c., Pittsburgh, for No. 28 in force and closed with prices ranging from 4.75c. to 5c. there was a thorough liquidation of the cheap sheets and the buying demand at the high prices was no close indication of the actual rate of consumption. There is little doubt that many regular consumers of galvanized sheets turned to other materials as substitutes, and some of the business will probably not return when galvanized sheets reach a normal level again.

Monthly averages of open quotations have been as follows, at Pittsburgh, for sheets and f.o.b., East St. Louis, for spelter:

	No. 28 Black Sheets, Cents per Lb.	No. 28, Galvanized Sheets, Cents per Lb.	Spelter, East St. Louis, Cents per Lb.
January	1.80	2.80	6.33
February	1.80	3.09	8.62
March	1.80	3.40	9.80
April	1.80	3.40	11.22
May	1.80	3.60	15.52
June	1.76	4.80	22.14
July	1.74	4.65	20.53
August	1.85	4.40	14.19
September	1.91	3.68	14.10
October	2.03	3.57	13.89
November	2.30	4.07	17.14
December	2.50	4.75	16.25
Year 1915	1.92	3.93	14.14
Year 1914	1.89	2.87	5.11

The above figures show that the black sheet market did not advance during the first seven months of the year, but indeed showed a slight weakening tendency. This is to be ascribed in chief part to the fact that the reduced production of galvanized sheets released sheet-mill capacity which sought employment in marketing the black product. Eventually, however, the black sheet market did advance, by a total of fully $14 per ton for the year, or substantially the same advance as occurred in the leading finished steel products—steel bars, plates and shapes.

There was very little new construction in the sheet industry in 1915, which was to be expected under the circumstances above outlined.

BLUE ANNEALED SHEETS

A certain class of business is disputed between the jobbing mills and the light plate mills, comprising chiefly No. 12 and heavier, but not as heavy as ¼ in. When trade is slack, the plate mills capture a large part of this product. Tonnage output is nothing to them then. When business is good the plate mills seek orders for heavier plates, and leave the orders for light materia' to the jobbing mills. In 1914 the general demand was very slack with the plate mills and they made such a drive for this product that the blue annealed sheet market dropped to a very low level—1.30c. for No. 10. During the fore part of 1915 business was still drooping with the plate mills, but in later months they found plenty to do in heavy plates and the light material went to the jobbing mills, simply swamping them with orders. By the close of the year No. 10 blue annealed sheets were quotable nominally at 2.25c., Pittsburgh, as minimum, but actual sales had been effected in some instances at as high as 2.75c., representing an advance during the year of $20 to $30 per ton.

The way this business moves from the plate mill to the jobbing mill, or the reverse, is shown in an interesting manner in the official statistics. It chances that the material is classified according to the mill on which it is rolled, there being the plate mill production of material under ¼ in., and the sheet and jobbing mill production of "12 gage and heavier." The production in 1913 and 1914, in gross tons, is shown in the following table:

	1913	1914
Plate mills	197,697	320,337
Sheet mills	252,337	125,272
Total	450,034	445,609

The totals shown above approximate closely, and it is not to be assumed for a moment that the demand for one class of material was 62 per cent as heavy in 1913 as in 1914, while the demand for the other class of material was 50 per cent as heavy in 1914 as in 1913. There was simply a large amount of business that went

to a different class of mills. The 1915 statistics, when issued, will show an alignment comparing with that of 1913 rather than that of 1914.

TIN PLATE

The production of tin plate in 1915 was probably a trifle under 1,000,000 gross tons, comparing closely with the outputs in 1914 and 1912—931,241 and 962,971 gross tons respectively—and well exceeding the output of the intermediate year 1913, which was only 823,719 tons.

An exceptionally heavy export demand for tin plate arose in the second quarter of the year, and during practically all the second half the actual volume of exports was regulated chiefly by ocean shipping facilities, the movement in some months exceeding 20,000 gross tons, and constituting 20 to 25 per cent of the production. Until this development the export business had generally run about 5000 tons a month. Prices on export tin plate were frequently higher than obtainable in the domestic market, and were rarely lower.

The tin-plate price for the 1916 season was announced Nov. 11, at $3.60, Pittsburgh, per box, for 100-lb. cokes, comparing with $3.20 announced Dec. 3, 1914, for the 1915 season. The advances in pig tin and in sheet bars meanwhile practically covered the advance of 40c. per pox, but the tin-plate manufacturers were confronted with unusual uncertainties, there being a danger that pig tin exports from the British possessions would be shut off, while sheet bars, although purchased on contract, might not be obtainable in suitable deliveries. As a result the contracting for 1916 proceeded with closer adherence to the open tin-plate price than had obtained in immediately preceding years. The possibility of Great Britain placing an export duty on pig tin was covered by a clause in the tin-plate sales contract, imposing an advance of two cents per box of tin plate on every cent per pound duty that might be levied.

Considerable new construction was undertaken in the tin-plate industry during the year, the largest being that of the McKeesport Tin Plate Company—20 mills in addition to the 22 mills operated for several years. The new mills, however, will hardly contribute to the 1916 season's consumption. The Standard Tin Plate Company completed 10 new mills at the close of the year, giving it a 20-mill plant, while the Phillips Sheet & Tin Plate Company added 4 mills to its Weirton plant, making 24 for the plant and 48 for the company. The Wheeling Sheet & Tin Plate Company began the addition of 6 additional mills, with another 6 to follow at some later time. The American Sheet & Tin Plate Company, for the first time in its history, undertook the construction of a complete tin-plate plant, announcing in October that it would build at Gary, Ind., a tin-plate department of 24 tin mills, with 50 pots.

It would be making a conservative statement to suggest that the supply of tin mills in the next couple of years will be adequate to the maintenance of competition, provided steel is obtainable in sufficient quantities.

The Metal Market in 1915

BY CHARLES LUNDBERG

The indispensability of nearly all the metals in the manufacture of munitions of war abundantly explains the prosperity that came in 1915, not only to the producers of metals, but to those who handle them and those who work them into various convenient forms.

Vast quantities of copper and spelter were used in the manufacture of cartridge brass. Rifling bands on shrapnel and high explosive shells consumed much copper. Lead was required for bullets, spelter in the form of sheets was used for containers of various kinds, antimony was an essential hardener in shrapnel bullets, and aluminum was consumed in various ways, even in powdered form. Brass rods and tubes were in great demand. These are but a few of the uses for which these metals were required and will be required until the war ends. In the year orders for thousands of tons of sheet brass have gone begging, as have orders for other products, despite increases in production on all sides.

Too much emphasis cannot be laid on the fact that it was war demand that made the year a good one for the trade, creating business that was shared by producers, selling agencies, brokers, jobbers and manufacturers. Many of them do not regard the fact happily, for the flow of supplies was all in one direction—to the Allies—though twice in the year it was reported that Germany had purchased heavily for delivery after the war, reports that generally were accepted.

COPPER

It is interesting to note that the year opened with electrolytic copper at its lowest point, 13c., cash, New York, Lake at the time being 13.50c.; while the highest quotation for electrolytic, 22.50c., was reached in the closing week of the year. Lake touched 22.50c. in June. The course of prices was upward from January to June, electrolytic reaching 20.37½c. cash, in the latter month. Then came a gradual easing off until electrolytic was 16c., cash, in late August, with Lake at 19c. From this time on quotations held their own, or mounted upward.

In the first half of 1916 domestic consumers of copper were not busy, at least so far as ordinary products were concerned. It was estimated that the brass mills were not more than 60 per cent engaged on regular products. Exports of copper were not good early in the year either, although January and May were exceptions in point of metal exported. Up to that time the outward flow of munitions had not got in full swing.

Throughout the year buying came in waves, but the periods of quiet on the part of domestic consumers in the first half of the year were long and trying. In the last half there was a decided improvement and occasional excited buying, as when, on Aug. 25, electrolytic advanced from 16c., cash, to 17c., and the following day went to 18c., both domestic and foreign buyers taking the metal.

In October occurred an interesting feature of the year, brought about by the previous scarcity and high price of Lake. Many copper consumers who had deemed Lake an essential to their business turned their attention to electrolytic and found that it answered their purposes quite well enough to pass muster, even in the making of cartridges. Not only was Lake difficult to obtain, but it was sold only on cash terms, whereas electrolytic sellers allowed payment in thirty days. Many mills began to use electrolytic, and several consumers declared they would adhere to its use if they had to pay any considerable premium for Lake. Perhaps it was for this reason that the premium for Lake was eliminated and for several weeks both grades were quoted at the same level.

In late October and in November consumers took millions of pounds of both Lake and electrolytic, the producers of which were at first content with 17.87½c., cash. It was noticed that Lake was preferred. Quotations advanced under the stimulus of buying to 18c. and on up to 18.87½c., cash, and at this time sellers were commended for curbing a market that might easily have run away. Among the November buyers were France, England and Sweden. Toward the end of the year the market was very active, with the result that producers soon became sold up well into 1916.

TIN

In this metal there were some startling events, the war, of course, being responsible for them. Twice in

the year the trade was stirred by restrictions inaugurated by Great Britain in her effort to prevent her enemies from getting tin or any products containing the metal. In early April the utmost excitement was thus created, and between April 6 and 9 the quotation for spot tin mounted from 48.50c. to 58c., New York. Dealers were required to sign statements agreeing not to resell to dealers, also to sign other documents stating to whom they did sell, and the metal was not to be exported except with the permission of Great Britain, and then only to its possessions or to its allies. Consumers, on the other hand, were required to sign a contract that they would not ship products into which tin went except to British possessions. All dealings were to be scrutinized by the British consul, and his approval obtained. The retailers who ordinarily take from 20 to 25 per cent of the metal were left out of the bargain, but this was rectified some time later.

In September, following announcement that previous restrictions must be observed, the guarantees that Great Britain's enemies would not be supplied were extended by the addition of clauses providing that orders for tin plates, tin canisters, tin foil, solder, babbitt metal, type metal, or metallic alloys containing tin would not be filled if these goods were intended for any country at war with Great Britain, and if sales were made to neutral countries particulars of such shipments must be given to the British consul. These requirements had little or no effect on prices.

In the first quarter of the year the disturbed conditions abroad caused quotations in New York to advance steadily. A cause of uneasiness was the freight congestion which existed in English ports in February. It was principally fears as to the continuance of supply that sent the quotation to 53.75c., March 19. The arrivals in March totaled only 1005 tons. At the time it was hoped that the situation would be relieved by the release of Banca tin accumulated in Holland, and to some extent the hope was realized. By April 27 the quotation was 42c. and by May 26, 37.87½c. In the next few months the market fluctuated, but not widely as compared with what had gone before, and August turned out to be a weak month, prices dropping to 33.50c. at its close. In September, and until the end of the year, the general trend was upward, 42.75c. being quoted Nov. 16. Toward the end of the year various reports which gained currency were of a nature to excite the trade and stiffen prices, one of these being that Great Britain intended to place an embargo on exports until she had accumulated a stock of 4000 tons, but this and several other rumors never gained official confirmation and consumers lost faith in bullish rumors.

The total deliveries in 11 months of 1915 were 43,550 tons, against 39,800 tons in the same period of 1914.

LEAD

Export shipments of lead were extremely heavy in 1915, and more would have been done in this direction had it not been for the scarcity and high cost of ocean freight room. The year was characterized by the most erratic changes in prices, there being sharp advances at times when the market was weak and declines were looked for. These advances had the invariable effect of causing independent producers to raise their prices and to excite activity on the part of consumers. One such flurry of activity left consumers with a bad taste; in fact, their confidence was destroyed for some time to come. Between June 1 and 12, lead advanced from 4.90c. to 7c., New York, in a market that was the most active of many months. It was reported that reserve stocks had been drawn on so heavily by war demand that a shortage was likely, and this despite the fact that production had increased 100,000 tons in 1914.

In the flurry, the usual differentials between New York and St. Louis were wiped out and while both were quoted at 7c., sales were made in the height of the excitement at St. Louis at 7.75c. In the week of June 16 to 23, prices came down almost as rapidly as they had gone up, the quotation June 22 being 5.75c., New York, and 5.35c., St. Louis. Then consumers realized that they were filled up with high priced lead, and in common with dealers and speculators they sought to sell.

When the year opened lead was quoted at 3.80c., New York, and 3.60c., St. Louis, and the domestic market was quiet. Betterment in prices was gradual from January to June; then came the episode described. In July the New York quotation dropped to 5.50c., and in August to 4.90c., and in September to 4.50c. All of this time the foreign business was strong and hampered only by the lack of ships. Late in October prices took an upward trend which continued until the end of the year.

The heavy and continued export demand gave New York an importance over that of St. Louis, a fact which was manifested by some of the London metal houses asking to be apprised by cable of any change in the New York market. Ordinarily the New York sellers watched the London market and the domestic market moved after London.

SPELTER

Beginning the year at 5.60c., New York, and 5.45c., St. Louis, spelter advanced steadily until in early June the quotations were 26.50c., New York, and 26c., St. Louis. Brass mill special was selling in June at about 30c., while very choice grades were not to be had even at 35c. Throughout the year there were heavy foreign shipments; in fact, these were a pronounced feature of the year. The exports began to be notable in August, 1914, and had reached large proportions by the end of that year. The exports of 1914 totaled 57,764 tons. In each of the previous nine years they had not exceeded 8000 tons. This year the exports will be tremendous in comparison with previous years.

In March, when spelter was around 9.50c., New York, repeated efforts were made on the floor of the New York Metal Exchange, it was thought in the interests of the galvanizers, to force the market down by free offerings at minimum prices. Whatever the intention, the effect was trifling and soon passed. The same effort was made in April with the price at 14c., New York. Throughout the year the galvanizing industry was run on only part time, in the early part of the year at 50 per cent of capacity, or less. The galvanizers purchased on recessions but their activity immediately sent prices up again.

About the middle of May the market touched 15c. and by the end of the month was up to 22c. The high cost of the metal upset the prices of products into which spelter enters, and the American Brass Company withdrew its quotations. Sheet zinc, June 9, was quoted at 33c., later in the month dropping to 27c., f.o.b. mill. In December it was 22c. Fancy grades of spelter, such as Horsehead and Bertha, were quoted at 40c., and unobtainable even at that figure. Throughout the year producers endeavored to induce the buying of futures but this consumers hesitated to do unless they had a war order in hand. The consequent heavy demand for spot held the market up.

ANTIMONY

This metal, much in demand as a hardener in the alloy used in making shrapnel bullets, fully participated in the war demand and resultant conditions. In January Cookson's and Hallett's were to be had around 14.50c. and 14c., New York, respectively. Quotations advanced steadily as the demand and scarcity developed. English grades became entirely nominal, inasmuch as Great Britain, in January, placed an embargo on the exportation of antimony. From that time, Chinese and Japanese grades supplied the demand. In April English grades commanded from 32c. to 35c., if found, while Asiatic grades were quoted at 27c. to 28c. In May a little resale English metal brought 40c. to 45c. At the end of May Chinese and Japanese brands were quoted at 35c. to 38c., but from late June to the middle of October prices tapered off until 28.50c. was quoted.

With the blocking of the Panama Canal by a landslide in October, quotations again started on the upward trend, until 40c. to 41c., New York, was quoted Dec. 1. Since then the market has hovered about 39c. to 39.50c.

Iron and Steel Prices for Eighteen Years

Monthly Averages Computed from the Weekly Market Quotations of "The Iron Age" in the Period 1898-1915

(With Supplement)

Accompanying this issue of THE IRON AGE is our annual chart, in which lines are plotted to indicate the course of prices for pig iron, Bessemer steel billets and some leading forms of finished iron and steel in the 18 years ended with 1915. The diagrams are based on monthly averages of prices quoted week by week in our market reports from the leading selling centers. The table below, which gives the monthly average prices on which the chart is based, includes also the average prices of No. 2 X foundry pig iron at Philadelphia, which have not been put in graphic form.

Bessemer Pig Iron at Pittsburgh, Dollars per Gross Ton (2240 lb.)

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January	9.87	10.87	24.99	13.15	16.70	22.15	13.91	16.85	18.35	23.15	19.00	17.34	19.90	15.90	15.05	18.15	14.96	14.59
February	10.05	11.60	24.80	14.43	16.93	21.45	13.66	16.41	18.35	22.85	17.90	16.78	19.34	15.90	14.90	18.15	15.09	14.55
March	10.39	14.59	24.72	16.31	17.37	21.85	14.25	16.35	18.28	22.85	17.86	16.25	18.60	15.90	15.09	18.15	15.09	14.55
April	10.41	15.03	24.70	16.75	18.75	21.28	14.18	16.35	18.19	23.35	17.49	15.78	18.27	15.90	15.15	17.90	14.90	14.55
May	10.30	16.20	21.00	16.30	20.75	20.01	13.60	16.16	18.10	24.01	16.93	15.84	17.52	15.90	15.13	17.70	14.90	14.59
June	10.34	18.51	19.72	16.00	21.56	19.72	12.81	16.65	18.23	24.27	16.90	16.05	16.60	15.90	15.15	17.14	14.90	14.70
July	10.25	20.65	16.75	16.00	21.60	18.89	12.40	14.85	18.41	23.55	16.83	16.46	16.40	15.90	15.20	16.70	14.90	14.95
August	10.35	21.75	15.60	15.75	21.62	18.35	12.81	15.20	19.00	22.90	16.23	17.03	16.09	15.90	15.46	16.52	14.90	15.95
September	10.78	23.43	13.87	15.75	21.75	17.22	12.63	15.91	19.54	22.90	15.90	18.05	15.90	15.90	16.15	16.65	14.90	16.85
October	10.36	24.18	13.06	15.89	21.75	16.05	13.10	16.54	20.35	22.00	15.71	19.53	15.90	15.44	17.80	16.60	14.84	16.95
November	10.15	24.78	13.48	16.00	21.68	15.18	14.85	17.85	22.85	20.65	16.59	19.90	15.82	15.00	18.02	16.02	14.59	17.51
December	10.58	24.90	13.43	16.31	21.75	14.40	16.65	18.35	23.75	19.34	17.40	19.90	15.90	15.03	18.15	15.77	14.70	19.65

Bessemer Steel Billets at Pittsburgh, Dollars per Gross Ton

January	14.93	16.62	34.50	19.75	27.50	29.60	23.00	22.75	26.25	29.40	28.00	25.00	27.50	23.00	20.00	28.30	20.13	19.25
February	15.06	18.00	34.87	20.31	29.37	29.87	23.00	23.50	26.50	29.50	28.00	25.00	27.50	23.00	20.00	28.50	21.00	19.50
March	15.25	24.30	33.00	22.88	31.25	30.62	23.00	24.00	26.70	29.00	28.00	23.00	27.50	23.00	19.75	28.50	21.00	19.70
April	15.06	25.37	32.00	24.00	31.50	30.25	23.00	24.00	27.00	30.12	28.00	23.00	26.75	23.00	20.00	28.50	20.80	20.00
May	14.85	26.75	28.90	24.00	32.20	30.37	23.00	23.50	26.40	30.30	28.00	23.00	26.12	22.60	20.80	27.37	20.00	20.00
June	14.65	30.10	27.25	24.38	32.37	28.87	23.00	22.00	26.63	29.62	25.75	23.00	25.30	21.00	20.87	26.50	19.50	20.50
July	14.50	33.12	21.00	24.00	31.75	27.60	23.00	22.00	27.25	30.00	25.00	23.50	25.00	21.00	21.50	26.60	19.00	21.38
August	15.85	35.40	18.20	24.20	31.06	27.00	23.00	24.00	27.80	29.25	25.00	24.13	24.62	21.00	22.12	26.00	20.25	23.13
September	16.00	38.87	16.93	24.88	29.50	27.00	20.00	25.00	28.00	29.37	25.00	25.00	24.40	20.75	23.62	24.87	21.00	24.10
October	15.56	38.75	16.50	26.70	29.70	27.00	19.50	25.62	28.00	28.20	25.00	26.25	23.75	20.00	26.00	23.30	20.00	24.63
November	15.06	36.50	18.95	27.00	28.50	24.00	20.25	26.00	28.88	28.00	25.00	27.13	23.30	19.50	27.00	21.00	19.25	26.50
December	15.80	33.75	19.75	27.50	29.12	23.00	21.20	26.00	29.50	28.00	25.00	27.50	23.00	19.25	27.00	20.00	19.00	30.60

Basic Pig Iron, f.o.b. Mahoning or Shenango Valley Furnace, Dollars per Gross Ton

January	....	....	....	....	....	....	....	15.46	17.06	21.90	16.90	15.50	16.87	13.25	12.35	16.41	12.50	12.50
February	....	....	....	....	....	....	....	15.25	16.82	22.00	15.97	15.12	16.31	13.65	12.25	16.30	13.19	12.50
March	....	....	....	....	....	....	....	15.55	16.85	21.50	15.62	14.94	16.00	13.75	12.81	16.11	13.00	12.50
April	....	....	....	....	....	....	....	15.06	16.88	21.50	15.25	14.05	15.94	13.75	13.00	15.87	13.00	12.50
May	....	....	....	....	....	....	....	15.06	17.00	22.90	14.91	14.12	15.19	13.32	13.00	15.15	13.00	12.50
June	....	....	....	....	....	....	11.76	14.60	16.94	22.40	15.25	14.62	14.70	13.05	13.12	14.50	13.00	12.59
July	....	....	....	....	....	....	11.20	14.00	17.12	21.75	14.51	15.05	14.50	13.12	13.40	14.37	13.00	12.74
August	....	....	....	....	....	....	11.69	14.32	17.70	21.25	14.69	15.25	14.12	13.00	13.94	14.06	13.00	14.06
September	....	....	....	....	....	....	11.60	14.86	18.44	20.06	14.43	15.90	13.70	12.80	14.37	14.00	13.00	14.75
October	....	....	....	....	....	....	12.19	15.25	19.55	19.50	14.04	16.94	13.15	12.52	15.98	13.90	12.81	15.00
November	....	....	....	....	....	....	14.00	16.87	21.37	18.12	14.72	17.25	13.25	12.42	16.37	13.09	12.48	15.75
December	....	....	....	....	....	....	15.70	16.75	21.50	17.50	15.60	17.05	13.40	12.25	16.50	12.71	12.50	17.50

Southern No. 2 Foundry Pig Iron at Cincinnati, Dollars per Gross Ton

January	9.50	10.31	20.69	13.45	14.55	21.65	12.37	16.25	16.75	26.00	16.15	16.25	17.25	14.25	13.25	16.95	13.88	12.40
February	9.25	11.69	20.50	13.12	14.75	21.50	12.12	16.25	16.75	26.00	15.75	16.13	17.06	14.25	13.31	16.69	13.81	12.40
March	9.25	13.75	20.30	14.00	14.75	21.37	12.10	16.25	16.65	26.00	15.50	15.05	16.30	14.25	13.50	16.31	14.00	12.27
April	9.25	14.50	20.19	14.50	16.87	20.15	12.50	16.25	16.63	25.06	15.20	14.25	15 37	14 25	13 75	15.65	13 75	12 34
May	9.37	14.56	19.75	13.85	18.35	18.87	12.25	15.81	16.75	24.25	14.75	14.50	15.00	13.95	14.15	14.94	13.75	12.40
June	9.30	16.00	18.75	13.37	20.19	17.75	11.80	14.65	16 44	24.10	15.25	14.70	14.85	13.44	14.25	14.06	13.63	12.50
July	9.25	17.56	16.81	13.00	20.75	16.15	11.81	13.94	16.06	23.85	15.00	15.75	14.75	13.25	14.70	13.75	13.30	12.71
August	9.37	18.35	14.25	13.00	23.06	15.19	12.00	14.40	17.30	23.00	15.25	16.38	14.31	13.45	15.06	14.06	13.25	13.71
September	9.55	19.94	13.62	13.06	25.00	14.75	12.00	14.37	18.69	21.50	15.65	17.35	14.25	13.31	15.87	14.25	13.25	14.15
October	9.75	20.75	12.87	13.75	25.65	13.50	12.81	15.31	20.00	20.95	15.75	17.88	14.25	13.25	16.80	14.35	12.90	14.78
November	9.75	20.75	12.95	14.00	23.62	12.00	15.19	16.60	23.38	19.50	16.00	17.75	14.25	13.20	17.25	13.87	12.90	16.15
December	9.90	20.75	13.75	14.25	22.44	12.05	15.85	16.75	25.00	17.00	16.25	17.45	14.25	13.19	17.25	13.95	12.50	17.10

Local No. 2 Foundry Pig Iron at Chicago (at Furnace), Dollars per Gross Ton

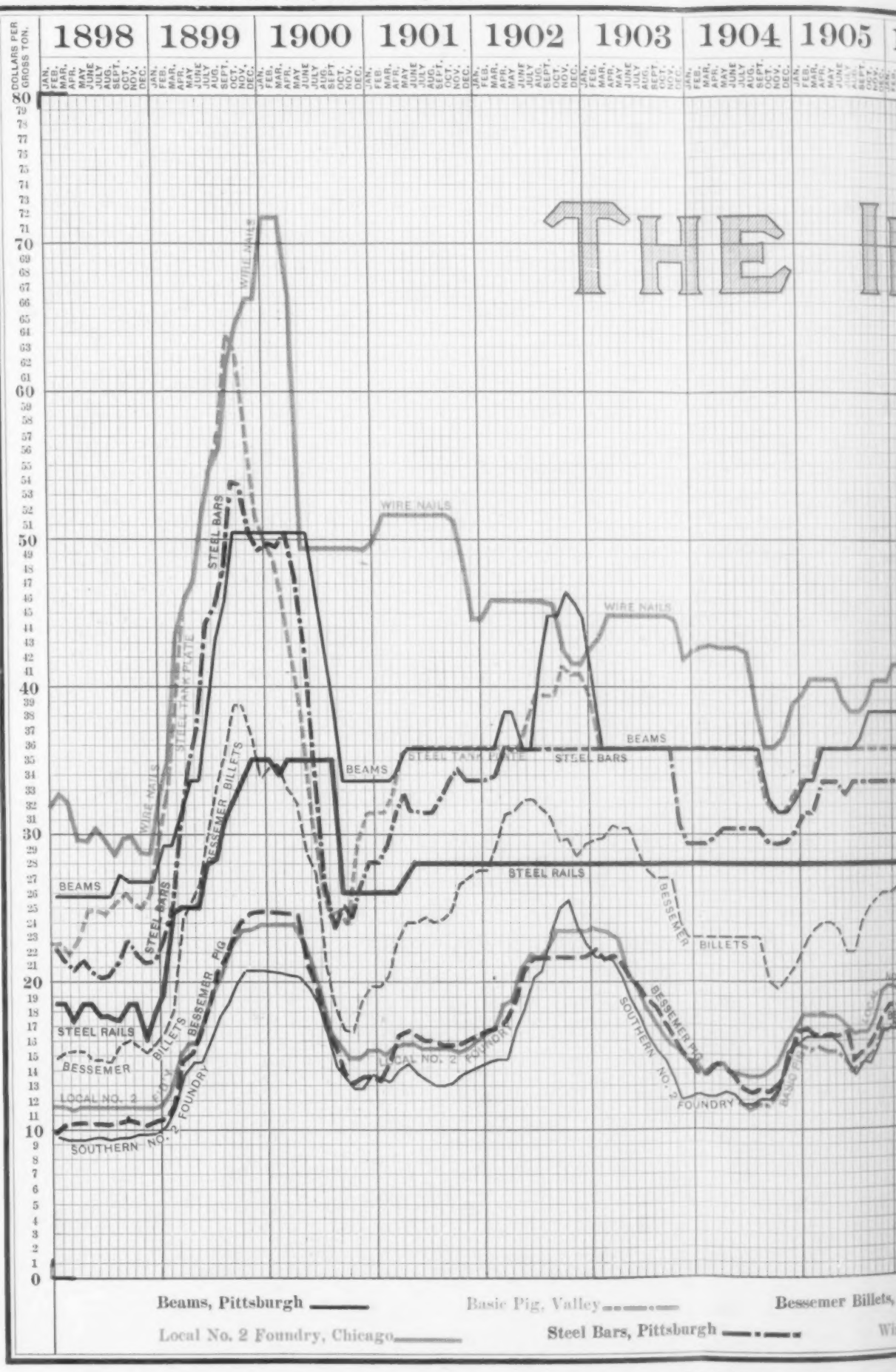
January	11.35	11.47	23.85	15.10	16.25	23.45	14.47	17.85	19.60	25.85	18.45	17.35	19.00	15.50	14.00	17.90	13.75	13.00
February	11.28	12.47	23.85	14.60	16.85	23.35	13.91	17.85	19.41	25.85	18.16	16.75	19.00	15.50	14.00	17.31	14.00	13.00
March	11.10	14.95	23.85	15.60	18.51	23.22	14.05	17.80	19.35	26.10	17.85	16.50	18.30	15.50	14.00	17.25	14.25	12.95
April	11.26	15.47	23.72	15.85	18.97	22.87	14.35	17.60	19.10	26.35	17.73	16.50	17.50	15.00	14.00	17.00	14.25	13.00
May	11.35	15.72	22.65	15.85	20.85	20.72	13.85	17.60	18.90	26.85	17.63	16.50	17.06	15.00	14.50	16.00	14.06	13.00
June	11.35	17.95	20.72	15.35	21.85	19.85	13.70	17.00	18.54	26.60	17.73	16.50	16.75	15.00	14.50	15.62	13.69	13.00
July	11.35	19.22	18.60	15.35	21.60	18.25	13.60	16.47	18.60	25.55	17.55	17.00	16.56	14.87	14.70	14.70	13.75	13.00
August	11.35	20.65	16.25	15.35	22.10	17.22	13.60	16.60	19.45	24.85	17.35	17.13	16.50	14.50	15.37	15.00	13.69	13.44
September	11.35	22.22	15.35	15.35	23.35	16.41	13.85	16.60	20.16	24.10	17.05	18.70	16.40	14.50	16.00	15.00	13.25	13.90
October	11.35	23.35	14.85	15.10	23.35	15.70	14.10	17.66	21.48	22.45	16.85	19.00	16.06	14.46	17.00	15.00	12.94	14.63
November	11.35	23.45	14.85	15.23	23.35	15.10	15.98	19.15	24.70	20.66	17.10	19.00	16.00	14.09	17.75	14.87	12.56	17.13
December	11.35	23.85	15.10	15.85	23.35	14.81	16.95	19.60	25.85	18.80	17.35	19.00	16.00	14.00	18.00	14.60	13.00	18.10

Standard Brands Eastern Pennsylvania No. 2 X Foundry Pig Iron at Philadelphia, Dollars per Gross Ton

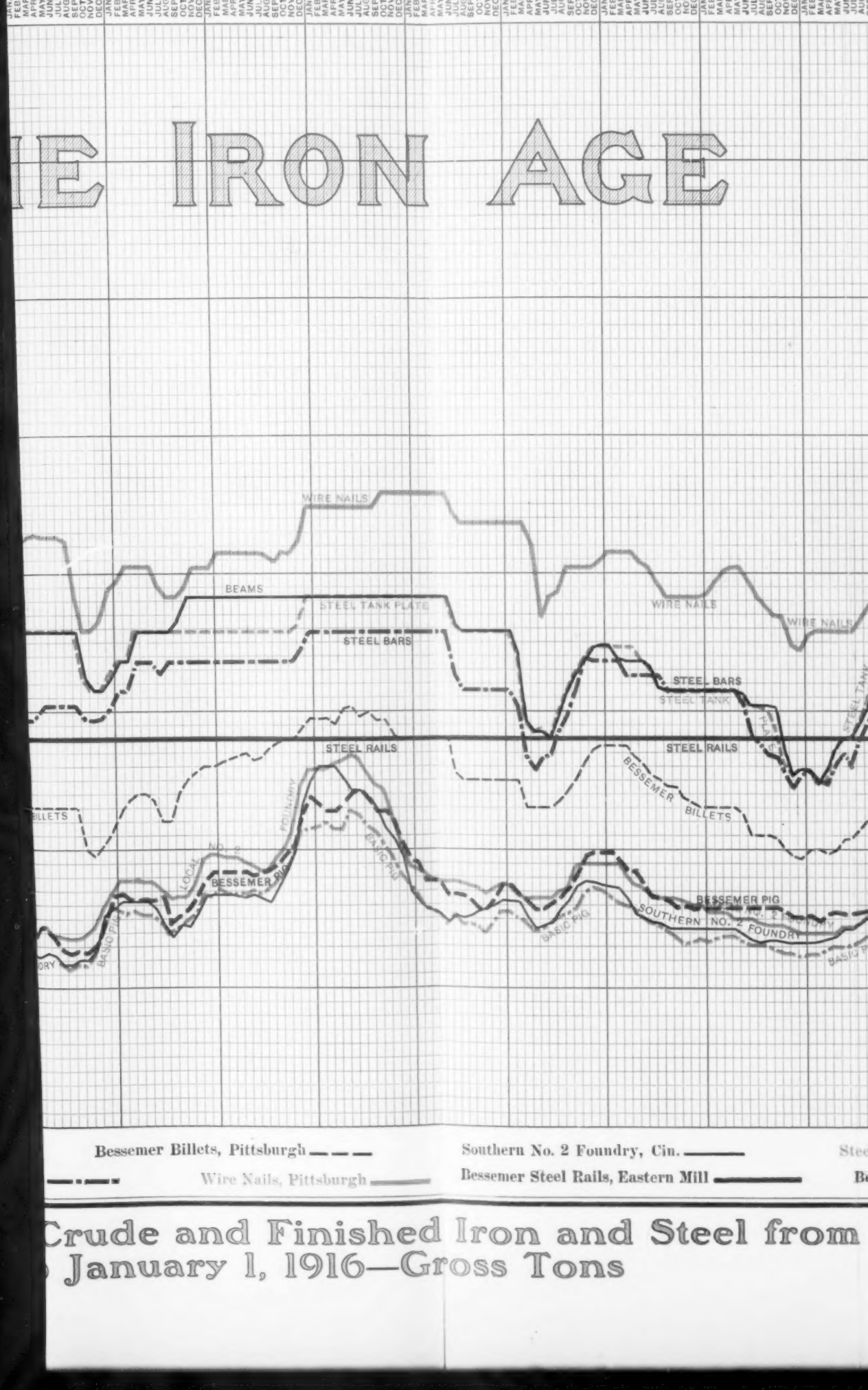
January	10.87	11.44	22.70	15.50	16.75	22.45	14.69	17.50	18.50	24.80	18.25	17.25	19.00	15.50	14.85	18.25	14.65	14.25
February	10.75	11.06	22.56	15.31	17.19	22.25	14.50	17.50	18.50	25.87	18.25	17.00	18.69	15.50	14.85	18.25	14.94	14.25
March	10.55	14.70	22.31	15.12	18.81	22.25	14.80	17.56	18.35	25.00	18.12	16.37	18.00	15.50	14.92	17.77	15.00	14.25
April	10.50	15.75	21.75	15.46	19.62	21.87	15.00	17.75	18.44	24.81	17.65	16.20	17.75	15.50	15.00	17.40	15.00	14.25
May	10.50	15.81	20.60	15.19	19.75	20.06	14.75	17.81	18.50	25.55	16.94	16.06	17.00	15.50	15.18	16.75	14.81	14.25
June	10.50	17.25	18.75	15.06	20.94	19.19	14.50	16.75	18.44	24.62	16.62	16.42	16.55	15.25	15.31	16.19	14.75	14.25
July	10.00	19.44	16.37	15.00	22.30	18.10	14.31	16.12	18.25	23.06	16.50	16.50	16.25	15.00	15.70	15.60	14.75	14.31
August	10.30	20.65	16.15	14.97	22.00	16.87	14.25	16.25	19.00	21.90	16.50	17.00	16.00	15.00	15.87	15.60	14.75	14.94
September	10.75	22.75	15.56	14.80	22.00	16.12	14.25	16.43	20.44	20.50	16.62	18.05	16.00	15.00	16.59	15.83	14.75	16.00
October	10.75	22.75	15.00	15.25	22.12	15.20	14.43	17.25	21.12	19.85	16.75	18.69	15.81	15.00	17.60	15.95	14.63	16.25
November	10.87	23.40	15.35	15.37	23.37	15.00	15.75	18.05	23.30	18.94	17.00	19.00	15.68	14.95	18.25	15.56	14.50	17.12
December	11.06	23.25	15.62	15.75	23.00	15.00	16.90	18.25	24.00	18.84	17.25	19.00	15.50	14.85	18.25	15.30	14.25	19.05

Soft Steel Bars at Pittsburgh, in Cents per Pound

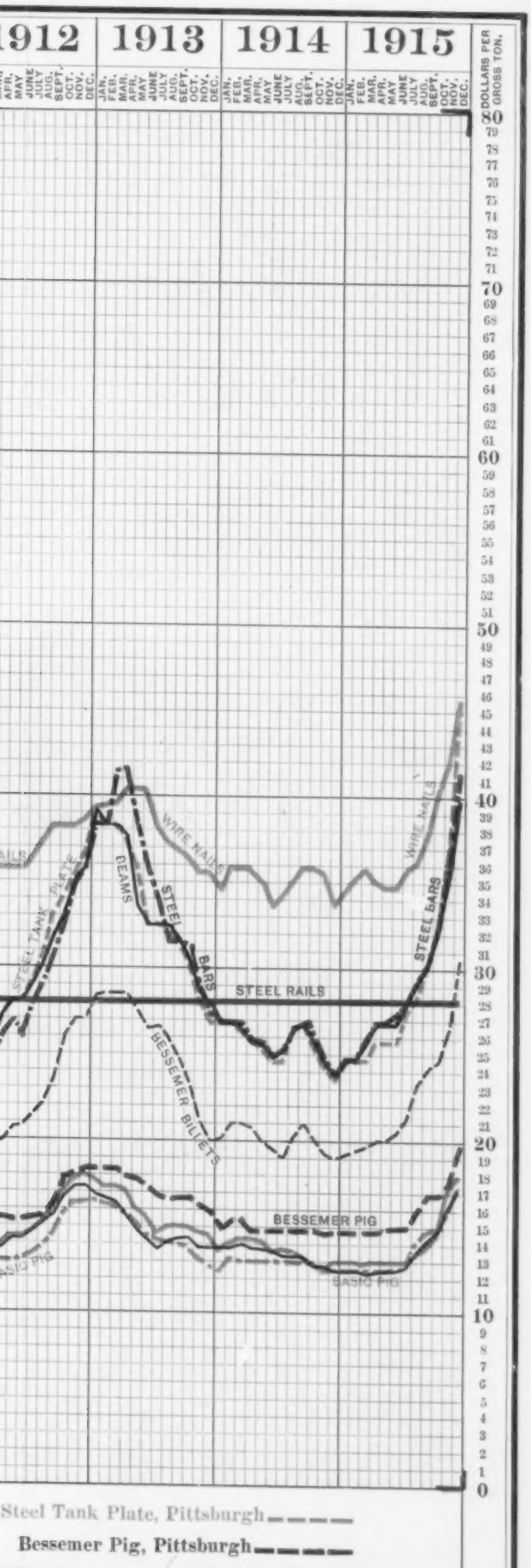
January	0.99	1.02	2.22	1.25	1.50	1.60	1.30	1.40	1.50	1.60	1.60	1.40	1.50	1.40	1.15	1.70	1.20	1.10
February	0.95	1.12	2.21	1.30	1.51	1.60	1.30	1.40	1.50	1.60	1.60	1.35	1.50	1.40	1.12	1.70	1.20	1.10
March	0.93	1.36	2.25	1.40	1.60	1.60	1.33	1.50	1.50	1.60	1.60	1.20	1.45	1.40	1.10	1.85	1.20	1.15
April	0.95	1.56	2.10	1.47	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.15	1.45	1.40	1.16	1.84	1.15	1.20
May	0.92	1.67	1.91	1.41	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.19	1.45	1.37	1.20	1.70	1.14	1.20
June	0.90	1.98	1.52	1.40	1.60	1.60	1.35	1.46	1.50	1.60	1.45	1.20	1.45	1.25	1.20	1.60	1.11	1.21
July	0.91	2.02	1.19	1.40	1.60	1.60	1.35	1.50	1.50	1.60	1.40	1.27	1.45	1.23	1.25	1.50	1.12	1.25
August	0.94	2.14	1.05	1.44	1.60	1.60	1.35	1.50	1.50	1.60	1.40	1.32	1.40	1.20	1.30	1.40	1.19	1.30
September	1.02	2.40	1.12	1.50	1.60	1.60	1.31	1.50	1.50	1.60	1.40	1.39	1.40	1.19	1.37	1.40	1.20	1.34
October	0.97	2.39	1.09	1.53	1.60	1.60	1.30	1.50	1.50	1.60	1.40	1.51	1.40	1.12	1.45	1.39	1.15	1.44
November	0.94	2.24	1.18	1.50	1.60	1.37	1.31	1.50	1.54	1.60	1.40	1.50	1.40	1.08	1.55	1.29	1.10	1.62
December	0.95	2.20	1.25	1.50	1.60	1.30	1.34	1.50	1.60	1.60	1.40	1.50	1.40	1.12	1.60	1.21	1.07	1.84



Fluctuations in the Prices of Crude an
to January



Crude and Finished Iron and Steel from
January 1, 1916—Gross Tons


1912
1913
1914
1915
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
DOLLARS PER GROSS TON.
80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
WIRE NAILS
STEEL TANK PLATE
STEEL BEAMS
STEEL BARS
STEEL RAILS
BESSEMER BILLETS
BESSEMER PIG
BASIC PIG
Steel Tank Plate, Pittsburgh
Bessemer Pig, Pittsburgh

m January 1, 1898,

Tank Plates at Pittsburgh, in Cents per Pound

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January.....	1.00	1.30	2.22	1.40	1.60	1.75	1.60	1.50	1.60	1.70	1.70	1.60	1.55	1.40	1.15	1.75	1.20	1.10
February....	1.00	1.47	2.17	1.40	1.60	1.60	1.60	1.50	1.60	1.70	1.70	1.52	1.55	1.40	1.11	1.71	1.20	1.10
March.....	0.97	1.75	2.03	1.47	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.30	1.55	1.40	1.12	1.70	1.18	1.10
April.....	1.02	2.05	1.87	1.57	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.27	1.55	1.40	1.21	1.68	1.15	1.15
May.....	1.10	2.12	1.69	1.60	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.20	1.51	1.39	1.25	1.60	1.12	1.15
June.....	1.10	2.32	1.39	1.60	1.09	1.60	1.60	1.60	1.60	1.70	1.62	1.25	1.48	1.35	1.25	1.45	1.10	1.16
July.....	1.09	2.45	1.16	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.33	1.41	1.35	1.30	1.45	1.10	1.22
August.....	1.12	2.55	1.09	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.40	1.40	1.34	1.35	1.44	1.18	1.26
September...	1.15	2.85	1.11	1.60	1.75	1.60	1.44	1.60	1.60	1.70	1.60	1.46	1.40	1.29	1.47	1.40	1.20	1.34
October.....	1.12	2.79	1.07	1.60	1.84	1.60	1.40	1.60	1.60	1.70	1.60	1.50	1.40	1.17	1.53	1.36	1.14	1.44
November...	1.11	2.52	1.31	1.60	1.82	1.60	1.40	1.60	1.62	1.70	1.60	1.54	1.40	1.13	1.59	1.26	1.08	1.65
December...	1.16	2.30	1.39	1.60	1.82	1.60	1.45	1.60	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.20	1.05	2.04

Beams at Pittsburgh, in Cents per Pound

January.....	1.15	1.30	2.25	1.50	1.60	1.80	1.60	1.50	1.70	1.70	1.70	1.60	1.55	1.40	1.15	1.75	1.20	1.10
February ...	1.15	1.30	2.25	1.50	1.60	1.60	1.60	1.50	1.70	1.70	1.7	1.52	1.51	1.40	1.11	1.71	1.20	1.10
March.....	1.15	1.40	2.25	1.52	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.30	1.50	1.40	1.15	1.70	1.19	1.10
April.....	1.15	1.50	2.25	1.60	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.40	1.21	1.68	1.15	1.20
May	1.15	1.50	2.25	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.39	1.25	1.50	1.14	1.20
June	1.15	1.70	2.07	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.62	1.25	1.48	1.35	1.25	1.45	1.11	1.20
July.....	1.15	1.94	1.90	1.60	1.84	1.60	1.60	1.60	1.70	1.70	1.60	1.33	1.41	1.35	1.30	1.45	1.12	1.25
August	1.21	2.05	1.74	1.60	2.00	1.60	1.60	1.63	1.70	1.70	1.60	1.40	1.40	1.35	1.35	1.45	1.19	1.30
September...	1.20	2.25	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.46	1.40	1.34	1.42	1.41	1.20	1.35
October.....	1.20	2.25	1.50	1.60	2.07	1.60	1.40	1.70	1.70	1.70	1.60	1.50	1.40	1.21	1.48	1.37	1.15	1.44
November ..	1.20	2.25	1.50	1.60	2.05	1.60	1.40	1.70	1.70	1.70	1.60	1.54	1.40	1.13	1.57	1.29	1.10	1.60
December...	1.20	2.25	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.25	1.07	1.78

Wire Nails at Pittsburgh, per Keg of 100 lb.

January	$1.42	$1.43	$3.20	$2.22	$1.99	$1.89	$1.89	$1.75	$1.85	$2.00	$2.05	$1.95	$1.85	$1.71	$1.57	$1.75	$1.54	$1.54
February ...	1.45	1.57	3.20	2.30	2.05	1.92	1.90	1.80	1.85	2.00	2.05	1.95	1.85	1.75	1.60	1.75	1.60	1.57
March.....	1.43	1.94	3.20	2.30	2.05	2.00	1.91	1.80	1.85	2.00	2.05	1.95	1.85	1.79	1.60	1.76	1.60	1.60
April.....	1.31	2.05	2.95	2.30	2.05	2.00	1.90	1.80	1.85	2.00	2.05	1.87	1.85	1.80	1.60	1.80	1.60	1.56
May.....	1.31	2.10	2.20	2.30	2.05	2.00	1.90	1.80	1.85	2.00	2.05	1.65	1.82	1.80	1.60	1.80	1.56	1.55
June.....	1.35	2.30	2.20	2.30	2.05	2.00	1.90	1.74	1.85	2.00	1.97	1.70	1.80	1.75	1.60	1.80	1.50	1.55
July.....	1.31	2.42	2.20	2.30	2.05	2.00	1.89	1.70	1.84	2.00	1.95	1.72	1.75	1.70	1.62	1.70	1.52	1.60
August.....	1.26	2.50	2.20	2.30	2.05	2.00	1.71	1.70	1.82	2.00	1.95	1.80	1.70	1.69	1.66	1.65	1.56	1.61
September...	1.32	2.76	2.20	2.30	2.03	2.00	1.60	1.74	1.86	2.05	1.95	1.80	1.70	1.65	1.70	1.65	1.60	1.69
October.....	1.33	2.87	2.20	2.28	1.89	2.00	1.60	1.80	1.85	2.05	1.95	1.80	1.70	1.64	1.70	1.63	1.60	1.80
November...	1.28	2.95	2.20	2.17	1.85	1.97	1.62	1.80	1.88	2.05	1.95	1.80	1.70	1.55	1.70	1.59	1.50	1.87
December...	1.27	2.95	2.20	1.99	1.85	1.87	1.73	1.80	2.00	2.05	1.95	1.85	1.70	1.53	1.72	1.55	1.51	2.04

Brief History of Eighteen Years of Price Fluctuations

In plotting the lines on the accompanying chart, those representing finished material have been derived by multiplying the market prices of finished material per pound by 2240, so that the traversing lines would show the exact price relation between gross tons of all products. In the above tables, however, while pig-iron and steel billet prices are in dollars per gross ton, those for finished material are stated in the usual way, in cents per pound.

The chart starts with 1898, as that was the year in which the depression following the panic of 1893 showed its most disastrous effects upon iron and steel prices. The low points of 1898 make the peaks of 1899 the very striking feature of the chart. After the starved consumption of the panic period, demand developed in 1899 that found capacity entirely inadequate. Almost as striking in the other way are the declines of 1900. In 1901 prices were fairly steady, with advances in the latter part of the year bringing another series of high points in 1902, though these are moderate in comparison with 1899. The sharp decline of 1903 is distinctly shown; the slight further decline extending over nine months of 1904, with advances in the latter part of the year; some reaction in 1905, followed by advances in the latter part of the year and a comparatively stable level for the first half of 1906. Then came a strong movement upward, until substantially the levels of 1902 were reached, followed by recessions after the middle of 1907 in pig iron and billets, but finished material prices were held in the weeks following the October panic. The cooperative movement among steel manufacturers modified the decline in the depression of 1908 and in the spring of 1909 came abrupt declines in response to the insistence of some steel manufacturers, particularly of bars, that prices had been kept too high. These cuts stimulated buying which gave the strong upward trend of the second half of 1909. In general, 1910 was a year in which the price movement reversed that of 1909, pig iron reaching again its low points of 1909, while finished materials only retraced part of the distance to the bottom touched after the open market declaration of February, 1909. Steadily declining prices marked 1911. The break in finished material in May, following notice by the Republic Iron & Steel Company that it proposed to reduce its prices, is plainly indicated in the pitch of the curves. There was a slight recovery in December. Early in 1912, however, active competition developed a further decline and the low point for the year was touched in February in some products and in March in others. Gradually rising prices marked the late spring and summer and fall months. The high prices paid for early deliveries were a prime feature of the first four months of 1913. In May prices for early and for future delivery came closer together and by June premiums on prompt steel had practically disappeared. Business fell off as the summer advanced. This became more pronounced later and in the last four months of the year price declines became marked. In 1914 finished materials gradually drooped as consumption fell off. There was an effort to advance prices in August, under the belief that the war would cause an increased call for American steel. This demand was not large, however, and business at home continued to fall off, the lowest prices of the year being reached in December, when many plants operated only about one-third capacity. January, 1915, brought some activity to make up for the extreme depression just preceding. As spring came on war demand for steel increased and export prices advanced. An unparalleled scarcity of steel developed in the late summer and billets advanced rapidly. Plates late in the year went soaring and wire products reached the highest point for 15 years in December. Pig iron lagged until August and then rose, the advance by the end of the year being $5 or $6 a ton.

Prices used in plotting the charts are those asked by producers for delivery in from one to three months and thus do not represent the extreme prices paid at times for prompt delivery.

Cast-Iron Pipe Prices—1900 to 1915

The accompanying diagram shows the course of prices for the past 14 years on 6-in. cast-iron water pipe, f.o.b. New York City, in carload lots, per ton of 2000 lb. The table given below is presented for those desiring the data on which the pipe curve is constructed, but going back to 1900. The prices for the first 10 years were furnished by Daniel Runkle, at that time with the Warren Foundry & Machine Company, 11 Broadway, New York, and for the remainder of the period covered were averaged from weekly quotations in *The Iron Age:*

Cast-Iron Pipe Prices at New York, 6-Inch, per Net Ton

	1900	1901	1902	1903	1904	1905	1906	1907
January	$27.50	$21.75	$24.50	$29.25	$24.50	$28.00	$29.75	$34.25
February	26.75	22.25	25.00	29.25	24.25	28.50	29.50	34.25
March	26.75	21.50	26.25	30.75	24.25	26.75	30.50	34.00
April	26.50	22.00	26.00	31.00	24.25	27.00	29.75	33.50
May	26.00	22.25	27.75	30.75	24.00	27.25	31.00	34.25
June	24.50	23.00	28.00	30.75	23.50	27.25	32.50	33.50
July	24.75	23.75	28.50	30.75	23.50	27.25	30.25	34.00
August	23.50	23.75	29.50	29.50	23.50	27.75	30.50	32.50
September	22.25	23.50	29.50	29.00	23.00	27.25	31.00	33.00
October	21.75	24.00	29.50	26.00	23.25	28.25	33.00	33.50
November	21.75	24.50	30.75	24.50	25.00	29.00	33.25	28.50
December	21.75	23.75	29.25	24.25	27.00	29.25	35.50	28.00

	1908	1909	1910	1911	1912	1913	1914	1915
January	$27.00	$24.50	$25.50	$22.00	$22.00	$25.00	$22.00	$20.00
February	26.75	24.25	25.50	21.50	22.00	24.75	22.00	20.00
March	26.25	25.25	25.50	21.00	22.00	23.87	22.00	20.00
April	26.25	25.00	25.50	21.00	21.25	23.50	22.00	21.60
May	26.25	25.25	25.50	21.00	21.00	23.00	20.88	22.00
June	25.75	26.00	25.25	21.00	21.00	23.00	20.50	22.25
July	25.75	26.25	24.00	21.00	22.10	23.00	20.50	22.50
August	25.25	26.00	23.50	21.00	22.00	23.00	20.50	23.25
September	25.75	25.75	23.50	21.00	23.12	23.00	20.40	24.37
October	25.75	25.50	23.00	21.00	24.50	23.00	20.00	25.25
November	25.00	25.87	22.12	21.40	24.12	23.00	20.00	26.50
December	25.50	25.70	22.00	22.00	24.62	22.33	20.00	27.60

To show how closely cast-iron pipe prices follow the fluctuations in pig iron, we have added to the pipe curve another giving the course of prices on gray forge pig iron at Philadelphia and vicinity, as gray forge is largely used in making pipe. The prices on which this curve is constructed, also going back to 1900, have been averaged from weekly prices in *The Iron Age* and are as follows:

Gray Forge Pig Iron, Philadelphia and Vicinity, Gross Ton

	1900	1901	1902	1903	1904	1905	1906	1907
January	$20.37	$14.50	$15.75	$21.75	$13.50	$16.25	$16.75	$23.50
February	20.25	14.50	15.75	21.25	13.50	15.75	17.00	23.50
March	19.25	14.00	17.50	20.00	12.75	16.25	16.75	23.50
April	18.75	14.37	18.25	20.00	13.75	16.25	16.75	23.00
May	18.06	14.37	19.00	19.50	13.75	16.00	16.50	23.25
June	16.50	14.37	19.25	18.25	13.50	15.75	16.25	23.00
July	14.50	14.12	21.75	18.12	13.25	14.50	16.10	22.50
August	14.50	14.00	21.00	15.50	12.50	15.00	16.50	20.25
September	14.00	14.00	21.00	14.75	13.00	15.00	17.75	19.50
October	13.50	14.12	21.00	14.50	12.75	15.75	18.25	18.75
November	14.00	14.37	22.00	14.00	14.00	16.25	20.00	17.00
December	14.50	14.87	22.25	14.00	15.50	16.50	22.00	16.75

	1908	1909	1910	1911	1912	1913	1914	1915
January	$16.50	$16.25	$17.75	$14.25	$14.25	$17.65	$14.00	$13.50
February	16.50	16.25	17.50	14.25	14.25	17.31	14.00	13.44
March	16.50	15.50	16.90	14.60	14.25	16.87	14.00	13.25
April	16.00	15.00	16.62	14.75	14.37	16.56	14.00	13.25
May	16.00	15.00	16.00	14.70	14.50	15.81	13.81	13.25
June	15.25	15.25	15.65	14.50	14.62	15.37	13.75	13.25
July	15.25	15.50	15.37	14.50	14.87	14.95	13.75	13.25
August	15.25	16.25	15.00	14.30	15.37	14.62	13.75	14.50
September	15.50	17.00	14.75	14.45	15.87	14.56	13.75	15.13
October	15.50	17.50	14.50	14.25	16.87	15.00	13.62	15.25
November	15.75	18.00	14.37	14.25	17.62	14.75	13.50	16.05
December	16.00	18.00	14.25	14.25	17.75	14.58	13.50	17.63

The Ashland Iron & Mining Company, Ashland, Ky., has been authorized by its stockholders to issue $1,500,000 of bonds and to increase its capital stock from $1,000,000 to $2,500,000. The building of an open-hearth steel plant at Ashland is understood to be contemplated.

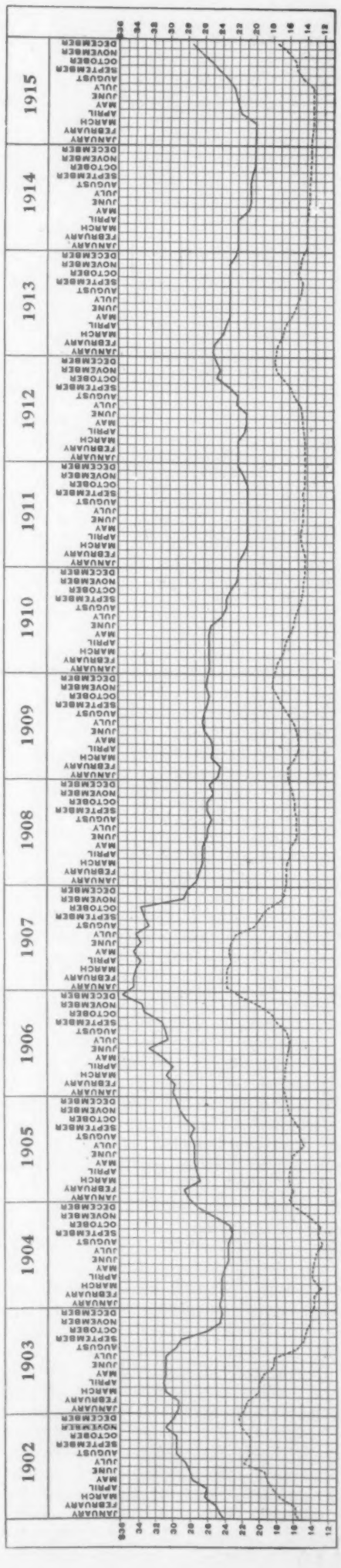


Diagram Showing the Course of Prices of Cast-Iron Water Pipe at New York City for the Past Fourteen Years, Compared with the Course of Prices on Gray Forge Pig Iron at Philadelphia. The Pipe is 6-Inch, Class B, Carload Lots, Priced per Ton of 2000 Pounds. The Heavy Black Line Indicates the Pipe Prices and the Dotted Line the Pig-Iron Prices

Connellsville Coke Prices for Fifteen Years

We present below tables showing monthly prices of prompt shipment Connellsville furnace and foundry coke for 15 years, 1901 to 1915, inclusive, averaged from weekly quotations in THE IRON AGE.

Average Prices of Prompt Connellsville Furnace Coke, per Net Ton at Oven

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January	$1.75	$2.90	$5.00	$1.60	$2.46	$2.62½	$3.53	$1.92	$1.59	$2.55	$1.40	$1.82	$3.88	$1.85	$1.50
February	1.75	2.50	5.00	1.52½	2.56	2.14	3.50	1.86	1.50	2.12½	1.45	1.78	2.52	1.85	1.50
March	1.90	2.87½	5.00	1.65	2.43	2.24	3.02	1.72½	1.60	2.00	1.55	2.12½	2.40	1.90	1.50
April	2.00	2.50	4.20	1.60	2.07½	2.45	2.72½	1.57	1.60	1.77½	1.50	2.39	2.15	1.86	1.50
May	2.00	2.50	3.50	1.50	1.87½	2.46	2.16	1.50	1.57½	1.66	1.50	2.28	2.13	1.77	1.50
June	1.87½	2.60	3.00	1.45	1.82	2.32½	1.89	1.55	1.52½	1.65	1.42	2.02	2.11	1.75	1.56
July	1.75	3.00	2.50	1.45	1.81	2.51	2.40	1.57½	1.58	1.59	1.44	2.21	2.45	1.75	1.64
August	1.75	3.87½	2.25	1.45	1.80	2.76	2.62	1.50	1.66	1.57	1.46	2.21	2.50	1.70	1.50
September	1.75	5.00	2.20	1.45	2.10	2.85	2.82½	1.50	2.39	1.60	1.50	2.37½	2.29	1.65	1.61
October	1.77	8.00	1.90	1.47½	2.61	2.84	2.85	1.53	2.76	1.59	1.50	3.41	2.08	1.60	2.03
November	1.95	6.00	1.75	2.04	2.95	3.13	2.41	1.72½	2.74	1.50	1.52	3.94	1.82	1.52	2.28
December	2.14	6.00	1.62½	2.12½	2.79	3.52½	2.06	1.82	2.67	1.44	1.60	4.00	1.75	1.50	2.64

Average Prices of Prompt Connellsville Foundry Coke, per Net Ton at Oven

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January	$2.25	$3.17	$6.50	$2.18	$2.38	$3.42	$4.25	$2.45	$2.00	$2.90	$1.90	$1.97½	$4.40	$2.50	$2.00
February	2.31	3.50	6.50	2.10	2.68	2.65	4.00	2.39	1.95	2.70	2.10	2.09	3.25	2.50	2.00
March	2.50	3.50	6.50	2.25	2.75	2.78	3.65	2.25	1.95	2.60	2.05	2.56	3.00	2.45	2.00
April	2.50	3.12½	5.50	2.15	2.70	2.95	3.31	2.22	1.86	2.45	2.00	2.69	3.00	2.40	2.00
May	2.50	3.15	4.50	2.00	2.55	2.81	3.00	2.03	1.85	2.20	1.81	2.58	2.85	2.40	2.00
June	2.37½	2.87½	3.50	1.90	2.40	2.65	3.00	2.00	1.80	2.17	1.76	2.40	2.80	2.32	2.00
July	2.25	3.20	3.25	1.80	2.35	2.79	3.00	2.00	2.00	2.15	1.82½	2.40	2.70	2.22	2.05
August	2.25	4.25	3.00	1.75	2.25	3.00	3.08	1.92	1.95	2.15	1.85	2.40	2.90	2.25	2.00
September	2.25	6.00	2.87½	1.85	2.50	3.19	3.20	1.90	2.55	2.12	1.85	2.54	2.90	2.10	2.07
October	2.25	9.00	2.87½	2.00	3.00	3.31	3.25	2.10	2.90	2.10	1.81	3.65	2.81	2.00	2.35
November	2.31	7.00	2.50	2.25	3.50	4.00	2.75	2.20	3.25	2.05	1.85	4.25	2.60	1.92	2.88
December	2.39	7.00	2.25	2.35	3.50	4.12½	2.50	2.25	3.20	1.97	1.90	4.50	2.50	1.90	2.95

Attention should be called to the peculiar conditions prevailing in the coke market in the last half of 1902 and the first half of 1903. In all this period coke prices were seriously affected by the extraordinary demand for coke caused by the scarcity of anthracite coal resulting from the great strike of anthracite coal miners which began in the spring of 1902 and was not settled until late in that year. For several months blast furnaces and foundries were greatly hampered in their operations by inability to secure a regular supply of fuel. Prompt furnace and foundry coke at this time sold as high as $11 per ton at oven, and it is possible that even higher prices may have been realized. Blast furnaces were often banked for a week or two awaiting coke deliveries, and many foundries ran intermittently. Coke was imported to some extent for the use of blast furnaces and foundries located near the seaboard, and foundry coke was shipped all the way to Chicago from Colorado. The quotations which are above given for this period are therefore to be regarded as to some extent conjectural.

Malleable Bessemer Pig-Iron Prices, Chicago

The table below shows monthly prices of malleable Bessemer pig iron at Chicago from 1901 to 1915, inclusive, averaged from weekly quotations in THE IRON AGE, per ton of 2240 lb.

	1901	1902	1903	1904	1905	1906	1907	1908*	1909	1910	1911	1912	1913	1914	1915
January	$15.00	$17.20	$23.24	$14.50	$17.50	$19.37	$26.00	$18.60	$17.09	$19.00	$15.50	$14.35	$17.90	$13.88	$13.00
February	14.87	17.75	23.00	14.50	17.50	19.19	26.00	18.25	16.75	19.00	15.50	14.14	17.31	13.94	13.00
March	15.75	18.50	22.87	14.00	17.50	19.00	26.25	17.50	16.50	18.40	15.50	14.00	17.25	14.25	13.00
April	16.50	19.50	21.82	14.00	17.50	18.77	26.50	17.50	16.50	17.50	15.25	14.00	17.05	14.25	13.00
May	15.45	21.80	20.77	14.00	17.37	18.35	26.60	17.56	16.66	17.06	15.00	14.40	16.00	14.06	13.00
June	16.25	22.00	19.50	13.85	16.65	18.00	26.25	17.37	16.50	16.75	15.00	14.50	15.62	13.88	13.00
July	16.25	22.75	18.66	13.75	16.37	18.37	25.62	17.50	16.90	16.56	15.00	14.50	14.65	14.00	13.00
August	16.30	23.00	17.59	13.75	16.50	18.95	24.80	17.50	17.12	16.50	14.80	15.10	15.00	14.00	13.44
September	16.00	24.00	16.94	13.50	16.56	20.12	24.40	17.25	18.50	16.40	14.50	16.25	15.00	13.25	14.30
October	15.75	23.90	16.25	13.75	17.37	21.32	22.40	17.00	18.50	16.06	14.50	17.10	15.20	13.00	15.25
November	15.81	23.87	15.00	15.87	19.00	24.16	20.25	17.00	19.00	16.00	14.35	17.87	14.87	12.88	17.13
December	17.00	24.00	14.50	16.50	19.50	26.00	18.75	17.00	19.00	16.00	14.35	18.00	14.63	12.90	18.20

*From this time on the prices are given as at furnace near Chicago, and 35c. to 50c. per ton should be added to get the price delivered to Chicago foundries.

Mahoning and Shenango Foundry Iron Prices

In the following table are presented the monthly average prices of No. 2 foundry pig iron at Valley furnace, namely, at furnaces in the Mahoning Valley, Ohio, and the Shenango Valley, Pennsylvania, from 1901 to 1915, inclusive, averaged from weekly quotations in THE IRON AGE:

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January	$13.20	$15.60	$22.30	$13.00	$16.12	$17.31	$24.60	$16.80	$15.44	$17.00	$13.75	$13.00	$17.50	$12.85	$13.00
February	13.16	16.20	21.95	12.47	16.00	17.25	24.12	16.00	15.06	16.69	13.75	13.00	17.00	13.19	13.00
March	13.97	17.76	22.00	12.91	16.00	17.12	24.00	15.56	14.50	16.19	13.75	13.12	16.69	13.25	13.00
April	14.10	19.30	20.99	13.01	16.00	16.50	24.00	15.15	14.00	15.62	13.75	13.25	15.55	13.25	12.75
May	14.10	19.92	20.32	12.47	15.55	16.30	25.00	14.87	14.19	15.31	13.75	13.25	14.62	13.00	12.94
June	13.66	20.60	19.37	11.96	14.81	16.19	25.12	15.00	14.90	14.75	13.56	13.25	14.06	13.00	12.69
July	13.20	21.10	18.02	11.67	14.25	16.44	22.80	14.80	15.19	14.31	13.50	13.37	13.87	13.00	12.70
August	12.97	22.35	16.34	11.87	14.15	17.71	22.50	14.50	15.31	14.15	13.50	13.69	14.00	13.00	13.62
September	13.10	22.30	14.98	11.71	14.56	19.56	20.87	14.47	15.75	13.75	13.44	14.44	14.00	13.00	14.70
October	13.60	22.17	14.09	12.50	15.50	21.35	19.80	14.36	17.12	13.94	13.37	16.10	13.84	12.90	14.87
November	14.41	23.25	13.32	14.60	16.83	23.87	19.00	15.25	17.25	13.90	13.20	16.94	13.50	12.75	15.50
December	15.20	21.25	13.22	16.19	17.35	24.00	17.37	15.50	17.00	13.75	13.00	17.25	13.50	12.75	18.30

Philadelphia Scrap Prices, 1896 to 1915

These Prices, Delivered Eastern Pennsylvania, Are Averaged from Weekly Quotations in THE IRON AGE

Heavy Melting Steel Scrap—Per Gross Ton

	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January	$13.00	$11.75	$10.19	$11.16	$20.00	$14.90	$18.30	$20.00	$11.56	$17.44	$17.33	$18.61	$11.70	$16.94	$17.00	$12.50	$12.19	$14.40	$10.40	$10.00
February	12.75	11.00	10.25	11.50	21.25	15.62	19.00	20.19	12.56	17.37	16.62	18.69	14.25	15.58	16.62	13.50	11.70	12.87	11.00	10.00
March	12.75	10.94	10.25	13.65	21.90	16.00	20.12	20.75	14.00	17.62	15.80	18.87	13.12	13.50	16.50	14.05	11.80	13.25	11.31	10.80
April	12.90	10.20	10.19	14.12	21.90	16.75	20.87	20.75	14.69	17.56	16.69	18.75	12.75	13.25	16.12	13.31	12.94	13.44	10.95	11.00
May	13.00	10.00	10.25	13.56	18.70	16.55	21.00	20.56	12.50	15.94	16.30	18.95	12.81	14.75	14.75	13.00	13.50	12.10	10.63	11.25
June	13.00	9.81	10.35	14.20	16.00	15.75	20.94	20.50	11.35	14.55	15.75	18.75	13.25	15.81	14.45	13.00	13.50	11.75	10.50	11.10
July	12.70	10.05	9.75	15.33	11.50	15.81	21.00	19.00	11.12	15.16	15.87	17.62	13.80	15.80	14.12	13.19	13.50	11.35	10.30	12.06
August	12.50	10.37	9.81	16.40	10.80	16.70	20.50	17.37	11.75	15.55	16.75	16.85	14.50	16.87	13.75	13.15	13.65	11.43	10.19	13.75
September	12.00	10.75	10.45	18.25	12.56	16.44	20.50	15.87	11.90	15.69	17.94	16.50	15.19	17.40	13.85	12.50	14.50	11.62	10.69	15.00
October	11.00	10.87	10.44	19.50	12.62	17.50	20.55	13.85	12.87	16.56	18.12	15.35	15.00	18.00	13.81	11.94	15.10	11.15	9.95	14.75
November	12.62	10.94	10.25	22.00	14.40	17.19	20.50	11.87	14.75	17.55	18.70	12.94	15.75	18.00	13.50	11.55	15.50	10.19	9.25	14.65
December	12.65	10.25	10.35	20.75	16.75	17.81	20.25	11.25	16.20	17.50	19.50	11.50	17.10	17.50	12.65	12.08	15.25	10.00	9.40	15.81

Heavy Cast Scrap—Per Gross Ton

January	10.00	9.77	9.25	9.58	17.37	14.50	14.40	19.75	12.75	16.00	16.00	21.70	15.30	15.87	17.00	14.00	13.42	14.50	12.00	12.00
February	10.00	9.60	9.25	10.91	17.37	14.00	14.81	19.81	12.81	15.62	15.87	22.00	15.00	15.00	16.12	14.38	13.00	14.37	12.88	12.00
March	10.00	9.57	9.25	11.80	17.15	14.00	16.00	20.00	13.30	15.75	15.50	22.25	15.00	14.00	16.00	14.40	13.12	14.00	13.00	12.00
April	10.00	9.30	9.25	13.00	16.62	14.00	17.06	20.00	13.37	16.00	15.50	21.25	15.00	14.10	15.87	13.44	13.62	13.94	13.00	11.75
May	10.00	9.00	9.25	12.75	15.60	13.95	17.70	19.25	12.50	15.19	15.40	20.80	14.87	14.69	15.06	13.13	13.75	13.60	12.25	12.13
June	10.00	9.00	9.20	13.25	14.00	13.52	18.25	18.37	11.60	14.20	15.37	20.75	14.25	15.00	15.00	13.00	13.75	13.25	12.00	12.25
July	10.00	9.30	9.00	13.68	13.00	13.62	17.75	17.50	11.25	14.00	15.12	19.25	14.00	14.85	14.94	13.06	13.75	13.00	12.00	12.38
August	10.00	9.50	9.00	14.25	13.30	13.75	18.25	15.87	11.50	14.40	16.30	18.60	14.25	15.37	14.25	13.20	13.75	12.87	12.00	13.30
September	10.00	9.50	9.20	15.06	14.37	13.75	19.00	14.75	11.50	15.12	17.44	18.00	15.25	15.90	14.00	12.69	13.96	12.81	12.00	14.00
October	9.50	9.69	9.25	16.87	13.50	13.75	19.50	13.90	12.37	15.75	18.37	17.60	15.25	16.94	14.00	12.44	14.50	13.50	11.40	14.00
November	9.75	9.75	9.25	17.90	13.69	14.00	19.50	12.87	13.75	16.00	19.20	16.50	15.44	17.50	14.00	12.25	14.75	12.62	11.00	14.50
December	10.00	9.35	9.25	17.50	14.12	14.00	19.50	12.50	14.90	16.00	21.12	15.50	16.00	17.50	14.00	13.00	15.00	12.17	11.30	16.06

Machine Shop Turnings—Per Gross Ton

January	8.00	8.12	7.87	8.58	15.12	9.85	12.95	16.00	8.94	14.50	14.50	16.05	9.00	13.63	14.38	8.12	9.00	11.20	7.30	8.00
February	8.25	8.00	7.87	8.83	15.25	10.00	13.50	16.00	9.12	15.75	13.81	16.25	9.87	12.00	13.50	9.19	9.25	10.37	9.00	8.00
March	8.50	8.00	8.00	10.25	15.10	10.89	14.44	16.50	9.45	15.19	13.55	16.75	9.62	10.08	12.80	10.00	8.80	10.12	8.75	8.13
April	8.30	7.80	8.00	11.00	14.94	12.00	16.37	16.50	10.12	14.75	13.81	16.55	8.40	10.10	11.44	8.81	9.69	10.31	7.90	8.25
May	8.00	7.50	8.00	11.37	13.90	12.00	16.20	15.75	9.50	13.50	13.19	16.95	9.12	11.62	9.94	8.25	10.40	9.20	7.50	8.44
June	8.00	7.50	8.00	11.75	10.00	11.56	16.00	15.12	8.20	11.00	12.31	16.94	9.50	12.50	9.65	8.40	10.31	8.00	7.69	8.50
July	7.80	7.45	8.00	12.50	8.75	11.50	16.50	14.40	7.94	10.66	11.69	15.37	9.80	12.45	9.62	9.00	10.50	7.85	7.75	8.63
August	7.56	7.25	7.87	12.50	8.20	11.50	16.12	13.00	8.56	12.90	12.65	14.30	10.75	13.50	8.81	9.30	10.65	8.00	7.94	9.80
September	7.75	7.70	8.00	12.75	8.50	11.56	16.00	11.00	8.75	13.62	13.75	14.00	11.50	14.35	8.75	8.19	10.94	8.00	8.56	10.56
October	7.75	8.19	8.00	14.00	8.50	11.75	16.00	10.50	9.00	14.25	14.25	12.85	11.80	15.50	8.62	8.00	11.40	7.85	7.90	10.13
November	8.06	8.19	8.00	15.55	8.85	12.25	16.00	9.75	9.62	14.40	14.85	10.50	12.94	15.06	8.50	8.00	11.50	7.00	7.50	10.25
December	8.25	8.00	8.10	15.50	9.75	12.75	16.00	9.19	12.50	14.50	15.94	9.00	13.90	14.15	8.15	8.91	11.00	7.08	7.65	11.00

Cast Borings—Per Gross Ton

January	7.62	7.12	6.87	7.58	13.62	7.94	8.00	10.00	6.50	11.19	11.00	13.55	7.00	12.62	12.22	8.12	8.31	10.85	7.80	8.00
February	7.75	6.81	6.75	7.83	13.50	8.00	8.00	10.69	7.00	11.25	10.31	14.50	8.37	11.00	11.50	8.81	8.00	10.37	9.19	8.00
March	8.00	6.75	6.94	9.25	13.60	8.00	8.62	11.13	7.35	11.31	9.85	15.37	7.75	8.17	11.20	9.60	8.50	10.06	8.94	8.00
April	7.90	6.60	7.00	10.00	13.25	8.37	10.00	11.55	7.56	11.25	10.25	15.69	7.50	8.65	10.38	8.25	9.37	10.25	8.30	8.00
May	7.75	6.50	7.00	10.37	11.50	8.75	10.05	11.06	6.75	9.87	9.50	16.00	8.12	9.87	9.84	7.75	9.60	9.17	8.00	8.00
June	7.75	6.50	7.00	10.75	8.25	8.00	10.37	10.31	6.35	8.00	9.37	16.12	8.75	10.50	8.80	7.90	9.50	8.25	8.00	8.10
July	7.35	6.35	7.00	11.00	7.62	7.81	10.50	9.40	6.12	7.83	9.31	14.37	9.00	10.40	9.50	8.63	9.56	7.85	8.00	8.50
August	6.75	6.25	6.87	11.00	6.55	7.25	10.12	8.31	6.50	9.20	10.25	13.50	10.00	11.44	9.31	8.80	9.75	7.94	8.50	9.80
September	6.75	6.60	7.00	11.31	6.69	7.31	10.00	7.50	6.75	9.87	11.25	12.81	11.00	12.45	9.25	7.69	10.06	8.18	8.56	10.44
October	6.65	7.19	7.00	12.94	6.75	7.50	10.00	7.15	7.11	9.87	11.37	11.20	11.25	13.37	9.06	7.50	10.85	7.90	8.00	10.25
November	7.18	7.19	7.00	14.25	7.25	7.87	10.19	6.81	7.75	10.60	12.50	8.37	12.00	13.19	8.50	7.50	11.37	7.50	7.50	10.05
December	7.25	7.00	7.10	14.25	7.75	8.00	10.00	6.44	9.80	10.50	13.00	7.00	12.75	12.10	8.15	8.09	10.83	7.17	7.65	11.00

No. 1 Railroad Wrought—Per Gross Ton

January	14.00	12.87	12.37	13.16	22.75	18.00	20.00	22.40	15.12	20.75	21.16	22.55	14.30	19.50	19.56	15.63	15.37	16.10	13.05	12.00
February	14.38	12.75	12.25	13.50	23.00	18.12	21.00	22.87	15.75	21.50	19.87	21.50	15.94	17.75	18.94	16.06	14.00	15.12	14.38	12.00
March	14.00	12.56	12.25	16.00	23.00	19.50	22.50	23.25	17.20	22.37	19.20	21.12	15.31	15.00	19.00	17.20	14.12	15.25	14.00	12.50
April	14.00	12.00	12.25	17.50	23.00	19.50	24.37	23.45	17.75	22.50	20.00	20.50	15.00	15.25	18.69	16.06	15.44	15.37	13.25	12.69
May	14.00	11.50	12.00	17.75	21.60	19.00	23.60	22.50	15.75	18.75	19.20	20.60	15.00	17.12	17.50	15.25	15.75	15.00	12.63	12.94
June	14.00	11.50	12.00	18.60	16.25	18.12	23.37	20.87	13.00	16.00	17.87	20.75	15.25	18.19	16.70	15.00	15.44	14.75	12.50	13.00
July	13.20	11.50	12.50	19.50	14.75	17.50	23.00	19.40	12.69	16.16	17.50	19.12	15.95	17.45	16.00	15.13	15.50	13.90	12.20	13.44
August	12.75	11.50	12.00	19.80	13.70	18.00	23.00	17.50	13.44	18.80	19.70	18.30	17.50	18.87	15.37	15.70	15.80	14.00	12.00	14.95
September	12.50	12.05	12.00	20.87	14.37	17.87	23.75	17.00	14.45	20.50	21.25	18.00	18.25	19.95	16.10	14.75	16.31	14.68	12.38	16.50
October	12.70	13.12	12.00	24.37	14.87	18.20	23.70	16.50	15.37	21.62	22.25	17.50	18.30	20.75	16.19	13.94	16.80	14.00	11.80	16.13
November	13.00	13.12	12.00	26.00	16.50	19.75	22.50	15.25	17.00	22.70	22.25	15.75	19.19	20.75	16.00	13.85	17.06	13.00	11.50	16.50
December	13.00	12.25	12.19	24.50	17.62	20.00	22.00	14.50	19.10	21.87	23.25	14.62	19.95	19.50	15.90	15.00	16.25	12.75	11.50	20.06

Old Iron Axles—Per Gross Ton

January	17.00	16.19	15.00	15.16	26.25	20.00	24.20	29.00	15.50	23.12	27.50	31.00	23.00	24.25	28.00	26.00	22.25	26.20	21.00	17.50
February	17.50	15.69	15.00	15.50	26.00	20.00	24.50	29.25	18.25	23.25	26.50	31.00	23.00	22.00	27.62	26.00	22.00	27.00	23.00	17.50
March	18.00	14.75	15.00	18.00	26.00	21.50	25.50	30.00	20.10	25.25	24.60	31.00	21.00	18.00	27.60	26.00	22.00	27.00	22.25	17.50
April	17.60	14.00	15.00	20.75	25.50	22.00	26.25	30.00	21.75	26.00	25.62	30.37	20.00	18.10	28.00	25.00	23.37	26.75	21.00	17.50
May	17.00	14.00	15.00	21.00	23.00	21.70	27.40	29.00	18.75	24.50	25.50	30.70	20.00	20.75	26.50	24.25	23.00	26.00	20.00	17.50
June	17.50	12.50	15.00	22.20	17.75	21.50	29.00	26.75	16.80	21.80	25.00	31.12	20.00	22.25	26.50	24.00	23.25	25.50	20.00	17.50
July	18.00	13.40	15.00	23.00	15.50	21.50	29.00	24.80	17.25	21.33	25.12	29.00	20.80	23.50	26.50	24.25	24.00	25.00	20.00	17.75
August	18.00	13.50	15.00	24.60	15.00	22.40	29.50	20.62	17.62	24.00	27.40	28.30	22.25	24.00	26.50	24.50	24.00	25.00	20.00	20.60
September	16.50	13.10	15.00	26.25	15.00	22.00	29.25	20.25	18.10	25.00	29.87	27.50	22.50	26.30	26.50	24.00	24.12	25.00	19.75	22.00
October	15.60	13.75	15.00	27.75	15.75	23.50	30.00	18.80	19.25	26.12	31.00	27.20	22.50	29.00	26.50	23.50	24.70	25.00	17.80	22.00
November	16.50	14.75	15.00	32.00	18.80	23.75	29.25	17.50	20.44	27.30	31.30	24.50	23.25	30.00	26.50	21.30	25.75	22.00	17.50	22.00
December	16.60	15.00	15.00	29.00	20.00	24.00	29.00	15.62	23.10	[illegible]2	32.00	23.00	23.95	30.00	26.50	21.50	26.00	21.00	17.50	25.75

Old Steel Axles—Per Gross Ton

January	.....	11.00	12.00	12.16	27.25	17.00	19.00	25.00	14.25	20.12	20.62	22.30	18.10	22.50	23.00	19.50	17.25	19.80	15.50	13.38
February	.....	11.87	12.00	12.68	27.00	17.00	.....	25.25	16.00	20.25	19.87	21.81	18.00	20.50	22.62	20.12	17.00	19.00	16.75	13.50
March	.....	12.75	12.00	15.15	27.00	17.00	22.00	26.00	17.00	21.25	19.30	22.00	17.62	17.00	22.40	20.80	17.00	19.00	16.25	14.00
April	.....	12.40	12.00	16.50	27.00	17.00	24.33	26.00	18.00	22.25	20.12	21.62	17.50	17.05	22.00	20.00	17.00	19.00	15.05	14.00
May	.....	12.37	12.00	16.50	24.20	17.00	25.40	26.00	15.50	19.62	19.60	21.80	17.62	18.75	20.62	19.31	17.00	17.70	14.00	14.00
June	.....	11.00	12.00	16.60	16.00	17.00	27.00	23.00	15.00	17.30	19.25	21.87	18.00	20.50	20.50	19.25	17.25	17.50	14.00	14.00
July	.....	11.60	12.00	17.00	16.00	17.00	27.50	21.80	14.75	17.00	18.75	20.50	18.30	21.30	20.12	19.37	17.50	17.50	14.00	14.25
August	.....	11.75	12.00	17.80	17.70	17.00	26.25	19.50	14.62	20.10	20.75	20.20	19.62	21.87	20.00	19.50	17.50	17.50	14.50	17.60
September	.....	11.60	12.00	18.75	15.00	17.50	26.00	18.00	15.20	21.00	22.25	20.00	21.25	22.90	20.00	19.00	18.00	18.12	14.81	19.50
October	.....	12.00	12.00	27.00	15.40	19.00	25.90	16.40	16.25	21.12	23.87	20.00	21.25	23.62	20.00	18.00	18.70	18.10	13.60	19.50
November	.....	12.00	12.00	30.00	17.00	19.00	25.25	14.50	17.87	21.50	23.30	19.62	21.62	24.00	20.00	17.20	19.75	16.44	13.00	20.70
December	.....	12.00	12.00	28.00	17.00	19.25	25.00	14.12	18.70	21.50	24.50	18.50	22.20	24.00	19.50	17.25	20.00	15.56	13.00	25.00

Old Carwheels—Per Gross Ton

January	12.00	10.25	9.37	10.58	20.50	17.00	16.95	20.30	12.87	16.00	18.75	23.00	18.20	16.00	17.50	13.00	12.37	16.20	12.20	11.00
February	12.25	10.25	9.87	11.58	22.00	16.87	17.00	22.62	13.00	16.00	18.75	23.00	16.62	15.50	16.81	13.44	12.00	15.37	12.63	10.63
March	12.50	10.00	10.25	14.30	22.00	16.50	17.44	24.50	13.20	16.70	17.70	23.62	15.00	14.00	16.75	14.00	11.94	15.00	12.50	11.00
April	12.50	9.55	10.25	15.00	22.75	16.75	17.75	24.20	13.50	17.00	16.75	24.00	14.00	14.05	16.06	13.19	12.87	14.87	12.00	11.00
May	12.43	9.12	10.25	15.00	21.20	17.50	19.50	23.62	12.00	16.00	16.75	24.80	14.00	14.25	15.12	13.00	13.90	13.75	11.75	11.38
June	12.25	8.81	10.30	15.60	18.00	17.50	19.75	21.87	11.20	14.90	16.09	25.37	13.75	15.00	14.90	13.10	14.00	13.12	11.19	11.55
July	11.70	8.85	10.00	16.33	18.00	17.50	20.60	21.30	10.75	14.25	16.19	25.00	13.50	15.05	14.25	12.94	14.00	12.30	11.00	12.38
August	11.50	9.25	9.87	17.30	17.00	16.70	20.00	19.12	11.25	15.20	16.75	23.90	14.75	15.62	13.94	13.00	14.05	12.37	11.25	13.25
September	11.00	9.25	10.20	19.12	17.50	16.50	20.00	18.25	11.80	15.50	18.37	23.00	15.00	15.80	13.75	12.56	14.25	12.75	11.25	14.00
October	10.30	9.87	10.25	21.12	15.75	16.20	19.25	16.40	12.37	16.37	20.94	22.40	15.00	17.50	13.75	11.75	14.87	12.46	10.10	13.75
November	10.43	10.00	10.06	23.20	16.50	16.12	20.50	14.43	13.81	17.10	22.00	19.00	15.62	17.50	13.50	11.35	15.00	12.00	9.50	14.05
December	10.75	9.25	10.10	21.00	17.00	16.75	20.00	12.75	14.60	18.12	23.00	19.00	16.00	17.50	13.25	12.33	15.50	12.00	10.00	15.63

Scrap Prices at Chicago, 1903 to 1915

These prices are averaged from weekly quotations in THE IRON AGE.

Heavy Melting Steel Scrap, per Gross Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January	$18.05	$10.13	$14.88	$14.95	$16.80	$11.05	$13.94	$16.00	$11.75	$10.75	$12.60	$9.35	$9.19
February	18.13	10.88	14.13	13.63	15.75	12.50	13.56	15.50	12.06	10.75	12.13	10.50	9.56
March	18.31	11.50	14.45	13.00	16.00	11.44	12.13	15.00	12.15	10.94	12.08	9.81	9.63
April	18.35	11.25	14.38	13.50	15.75	11.05	12.35	14.44	11.75	11.56	12.50	9.80	9.15
May	17.63	9.75	12.55	13.70	15.60	10.62	13.44	13.56	10.50	12.05	11.25	9.69	9.37
June	16.50	9.30	11.95	13.13	16.25	11.62	14.50	13.15	10.38	12.12	10.44	9.75	9.44
July	16.30	9.00	12.75	13.13	16.12	11.75	14.06	12.38	10.69	11.69	10.50	9.75	10.40
August	16.00	9.25	13.15	14.10	15.10	12.88	15.00	12.25	11.05	12.25	10.56	9.69	11.56
September	13.75	10.00	14.38	16.50	14.75	13.00	16.00	12.25	10.70	12.81	10.06	9.19	11.75
October	12.80	10.88	14.50	16.60	14.70	13.45	16.43	12.25	10.00	13.95	10.00	8.50	11.75
November	11.25	12.55	15.20	17.50	12.63	14.88	16.00	12.25	9.75	13.69	9.56	8.06	13.44
December	9.00	14.15	15.25	17.13	11.50	15.17	16.00	12.10	10.25	12.88	9.00	8.43	15.63

Old Steel Rerolling Rails, per Gross Ton

January	$23.50	$11.75	$16.00	$16.50	$19.00	$12.30	$15.81	$18.00	$13.69	$13.00	$16.15	$11.10	$9.62
February	23.50	13.13	15.13	16.25	19.00	13.00	15.12	18.00	13.63	12.80	15.50	11.81	9.87
March	22.13	13.00	15.30	15.70	19.00	12.19	13.06	17.80	13.65	12.75	15.00	11.56	10.25
April	22.00	13.00	15.44	15.75	18.50	12.60	13.20	17.69	13.44	12.88	14.63	11.50	10.25
May	22.13	11.88	14.06	16.00	18.60	12.94	14.44	17.12	13.49	13.50	13.95	11.31	10.25
June	21.00	10.80	12.95	15.88	18.94	13.94	15.50	16.50	12.38	13.50	12.69	11.50	10.25
July	19.00	10.31	13.56	15.50	18.00	14.50	15.40	15.88	12.25	13.50	12.25	11.50	10.30
August	19.00	11.50	14.35	15.90	17.00	15.63	16.12	15.31	12.65	14.00	12.12	11.50	12.25
September	17.33	11.81	15.25	17.63	16.75	16.18	17.15	15.25	12.75	15.00	12.25	10.75	13.35
October	15.40	12.38	15.63	18.63	17.15	15.80	18.00	15.25	12.44	16.30	12.15	10.00	13.31
November	13.50	14.75	16.30	21.15	15.06	17.19	18.00	15.06	12.30	16.50	12.00	9.50	14.44
December	10.60	16.00	16.50	21.00	12.94	16.95	18.00	14.20	12.50	16.50	11.33	9.50	16.63

Old Iron Rails, per Gross Ton

January	$24.00	$14.00	$21.13	$23.00	$27.40	$15.60	$18.81	$20.00	$15.00	$15.19	$17.05	$13.00	$11.38
February	24.00	16.50	20.00	21.75	25.50	17.12	18.25	19.25	15.25	15.25	16.25	13.13	11.63
March	24.00	16.60	19.60	20.75	25.00	15.44	16.94	19.00	15.35	15.31	16.25	12.94	12.00
April	23.75	16.88	19.75	20.88	24.88	15.00	16.10	18.50	14.69	15.56	16.19	12.75	11.85
May	23.75	15.88	18.50	21.25	24.50	14.81	16.63	17.62	14.69	16.25	15.90	12.75	12.39
June	21.00	14.65	17.15	21.25	24.50	15.50	17.00	17.00	14.38	16.25	14.75	12.75	12.25
July	19.70	14.13	17.81	21.25	23.75	15.90	17.00	16.75	14.25	16.25	14.00	12.15	12.25
August	18.50	15.32	19.35	21.90	20.65	16.56	18.38	16.25	14.25	16.30	14.00	12.00	12.25
September	17.75	16.00	20.88	23.50	20.25	17.35	19.20	16.00	14.50	16.88	14.00	11.70	13.25
October	17.00	16.69	22.13	26.00	20.05	18.00	20.75	16.00	13.88	17.95	13.90	11.13	13.50
November	16.25	20.13	22.90	28.00	17.63	18.38	20.62	16.00	14.75	18.25	13.50	11.00	14.94
December	13.00	22.00	23.00	28.00	15.50	19.50	20.00	15.70	15.00	17.68	13.16	11.00	16.00

No. 1 Railroad Wrought, per Net Ton

January	$19.50	$10.85	$18.19	$17.30	$16.35	$11.20	$13.81	$14.88	$11.75	$11.63	$12.70	$8.70	$8.69
February	19.50	12.50	17.00	15.88	15.50	12.44	12.88	14.69	12.00	11.30	12.19	9.50	8.87
March	19.75	12.80	16.40	14.88	15.25	11.25	11.43	14.45	12.30	11.44	12.13	9.06	9.00
April	20.40	12.50	16.06	14.50	15.25	11.00	11.90	14.19	11.69	12.31	12.38	9.00	8.65
May	19.13	11.38	14.19	14.50	15.45	10.75	12.81	12.87	11.38	12.75	11.25	9.00	8.94
June	16.13	10.50	13.50	13.50	16.06	11.69	13.38	12.75	11.25	12.57	10.56	9.00	9.00
July	14.65	10.44	14.13	13.50	15.06	12.15	13.16	12.44	11.00	12.06	10.55	9.00	9.15
August	14.19	11.13	15.45	14.50	14.40	12.69	14.44	11.94	11.10	12.50	10.62	8.94	10.44
September	14.06	11.85	16.31	16.13	14.38	13.44	15.35	11.94	10.94	13.13	10.19	8.37	11.00
October	13.55	12.50	17.00	17.50	14.60	13.60	15.94	11.75	10.44	14.25	9.60	7.87	11.19
November	12.00	15.44	17.50	18.00	12.32	14.38	15.31	11.94	10.20	13.50	9.00	7.56	12.94
December	10.00	17.55	18.00	17.25	11.00	14.83	14.75	11.65	10.75	13.06	8.50	7.90	15.38

Heavy Cast Scrap, per Net Ton

January	$17.30	$10.50	$13.81	$14.70	$17.80	$12.95	$13.06	$14.88	$12.19	$11.25	$12.90	$10.20	$9.19
February	16.63	11.38	13.13	13.50	18.25	13.00	12.75	14.88	12.13	11.25	12.69	10.87	9.00
March	18.13	12.00	13.40	12.75	19.50	12.12	12.19	14.50	12.25	11.31	12.50	10.37	9.00
April	17.80	11.13	13.81	12.94	18.88	12.05	12.60	13.69	11.81	12.06	12.44	10.25	9.00
May	16.75	10.25	12.50	13.40	18.55	11.50	13.31	13.13	11.00	12.20	11.60	10.06	9.00
June	14.63	8.80	12.40	13.50	18.94	12.00	13.81	13.00	10.75	11.81	10.63	9.75	9.60
July	14.20	8.94	13.38	13.50	18.44	12.15	13.44	13.00	10.50	11.75	10.70	9.65	9.25
August	14.00	9.88	13.20	14.00	16.75	12.75	14.06	12.75	10.55	12.15	10.87	9.50	9.62
September	13.00	10.70	13.38	15.38	16.81	12.88	14.75	12.75	10.10	12.81	10.62	9.19	10.10
October	12.40	10.05	13.63	15.90	16.25	13.25	15.63	12.50	10.25	14.20	10.40	9.00	10.50
November	11.63	12.69	14.30	17.50	14.00	13.75	15.12	12.50	10.35	13.50	10.06	8.56	12.13
December	10.50	14.15	15.00	17.50	13.00	13.92	14.75	12.30	11.00	13.25	9.83	9.00	13.75

Railroad Malleable Scrap, per Net Ton

January	$16.25	$8.25	$14.06	$15.00	$17.20	$10.40	$12.88	$15.00	$10.94	$10.88	$13.40	$9.25	$8.13
February	16.25	9.50	13.69	14.25	16.00	11.31	12.38	14.69	10.50	10.30	13.00	10.38	8.00
March	16.25	10.00	13.44	13.00	16.25	10.00	11.50	14.50	11.00	10.44	13.00	9.56	7.94
April	16.45	10.00	13.25	13.38	16.38	10.10	11.25	13.69	11.00	11.19	13.19	9.15	8.00
May	15.88	9.38	12.38	13.50	16.25	9.81	12.38	12.94	10.38	11.55	12.10	9.13	8.14
June	15.00	8.20	11.90	13.50	17.50	10.25	12.94	12.20	10.10	11.75	11.06	9.00	8.13
July	15.00	8.25	12.31	13.38	16.75	11.40	12.75	11.25	10.00	11.75	10.60	9.00	8.90
August	14.50	8.44	13.15	13.60	16.00	12.06	13.69	11.00	10.05	12.05	10.38	8.88	10.00
September	13.75	9.20	14.19	15.00	16.00	12.38	15.15	11.20	10.00	12.56	10.19	8.25	10.25
October	13.30	9.88	14.25	15.13	15.20	12.45	15.25	11.00	9.69	13.75	9.65	7.90	10.25
November	10.25	11.80	14.55	17.30	12.25	13.44	15.13	11.25	9.50	13.56	9.31	7.75	11.38
December	8.70	13.56	15.00	18.00	10.50	13.70	14.95	11.25	10.06	13.50	9.00	7.95	13.75

Frogs, Switches and Guards, Cut Apart, per Gross Ton

January	.....	.....	$14.88	$15.00	$17.40	$11.40	$14.00	$16.00	$11.50	$10.50	$12.65	$9.30	$9.19
February	.....	.....	14.06	14.75	16.25	12.38	13.56	15.50	11.88	10.50	12.13	10.50	9.86
March	.....	.....	14.50	13.70	16.50	11.69	12.50	15.00	12.10	10.88	12.13	9.81	9.63
April	.....	.....	14.25	13.50	16.50	11.50	12.55	14.50	11.63	11.38	12.44	9.90	9.15
May	.....	.....	13.31	13.70	16.90	11.56	13.44	13.69	10.38	11.80	11.30	9.69	9.38
June	.....	.....	12.10	13.13	17.25	11.63	14.50	13.15	10.20	11.88	10.44	9.69	9.44
July	.....	.....	12.75	13.25	16.81	12.30	14.15	12.38	10.44	11.56	10.50	9.75	10.45
August	.....	.....	13.15	14.30	15.50	14.00	14.88	12.25	10.70	11.95	10.56	9.69	11.56
September	.....	.....	14.38	16.63	15.50	13.63	15.95	12.25	10.38	12.63	10.19	9.19	11.75
October	.....	.....	14.50	17.13	15.30	13.85	16.63	12.25	9.94	13.75	10.00	8.75	11.75
November	.....	$13.25	15.40	18.30	12.69	14.50	16.06	12.25	9.65	13.44	9.56	8.19	13.44
December	.....	14.38	15.50	18.00	11.63	14.95	16.00	12.10	10.13	12.63	9.00	8.40	15.63

Old Carwheels, per Gross Ton

January	$24.00	$13.26	$16.56	$19.00	$24.90	$20.10	$15.75	$18.38	$13.00	$13.25	$16.95	$11.65	$9.94
February	24.00	14.13	16.38	19.00	23.50	16.94	15.25	17.88	13.00	13.05	16.75	12.44	10.00
March	24.00	14.50	15.75	18.6	23.88	15.50	14.69	17.00	13.25	13.00	16.75	11.88	9.94
April	24.00	14.00	15.88	18.75	25.00	14.06	14.50	16.50	13.25	13.25	16.75	11.55	9.75
May	22.88	13.13	14.81	19.00	25.20	12.88	14.81	15.75	12.75	13.90	15.05	11.50	9.75
June	21.75	11.20	14.25	18.00	25.38	13.00	15.81	15.50	12.55	14.13	13.94	11.50	10.19
July	21.50	10.63	14.38	18.00	24.25	13.30	16.00	14.81	12.50	13.88	12.90	11.25	11.30
August	21.38	11.13	14.95	18.50	24.50	15.50	16.25	14.50	12.85	13.70	12.75	11.25	11.04
September	20.25	11.10	15.75	19.75	24.50	15.50	18.05	14.00	12.81	14.38	12.63	11.06	11.80
October	18.00	12.00	16.00	19.31	24.38	15.25	18.31	14.00	12.50	16.00	12.10	10.65	12.00
November	15.75	14.25	17.10	22.60	23.13	15.50	18.50	13.50	12.10	16.69	12.00	9.81	13.31
December	13.00	16.25	18.75	25.00	22.00	16.00	18.50	13.50	13.06	16.75	11.88	9.60	14.56

Foundry Iron Prices Cincinnati and Chicago

The tables given below show the average monthly prices of No. 2 Southern foundry pig iron at Cincinnati from 1876 to 1915, inclusive, and No. 2 local foundry pig iron at Chicago from 1888 to 1915, inclusive. These prices are averaged from weekly quotations in the market reports of THE IRON AGE and are per ton of 2240 lb.

Southern No. 2 Foundry Pig Iron at Cincinnati, per Gross Ton

	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889
Jan.	$22.00	$20.00	$18.00	$17.10	$37.75	$22.50	$25.50	$21.62	$17.25	$15.62	$17.00	$20.12	$18.62	$14.75
Feb.	22.00	20.25	18.00	17.75	41.12	22.50	25.50	21.50	17.00	15.25	17.00	21.00	19.00	14.37
March	22.00	20.40	17.62	18.00	38.12	22.50	24.90	20.60	17.75	14.62	17.00	21.00	18.50	14.50
April	22.00	20.50	17.75	18.00	33.50	22.50	23.50	20.62	17.87	15.15	17.00	21.00	17.75	14.25
May	22.00	20.20	17.00	18.00	26.25	22.25	23.00	20.25	17.25	15.00	16.37	20.50	16.75	14.00
June	20.00	20.25	16.25	17.75	23.25	22.00	22.00	19.50	17.25	15.25	16.12	19.40	15.75	13.68
July	20.00	19.25	16.00	17.75	22.60	21.50	22.25	19.00	16.62	14.81	15.37	19.50	15.50	14.12
Aug.	20.00	18.00	16.20	19.50	24.00	21.50	22.60	18.50	16.00	14.87	15.25	20.00	15.80	14.50
Sept.	19.50	18.00	16.75	25.50	24.00	21.75	22.62	18.50	15.87	15.00	16.75	20.00	16.50	14.50
Oct.	19.50	18.00	17.00	33.50	23.50	22.00	22.37	18.50	16.25	15.00	17.00	19.75	16.50	15.31
Nov.	20.00	18.00	17.00	36.00	22.00	24.50	22.00	18.50	16.18	15.50	17.75	19.50	15.65	16.62
Dec.	20.10	18.00	17.00	35.00	22.25	25.00	22.00	18.37	16.25	16.37	18.60	18.87	15.50	17.56

	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
Jan.	$18.05	$13.81	$13.75	$12.50	$11.00	$9.25	$11.20	$11.00	$9.50	$10.31	$20.69	$13.45	$14.55
Feb.	17.75	13.75	13.62	12.12	10.75	9.25	11.00	9.75	9.25	11.69	20.50	13.12	14.75
March	16.00	14.00	13.10	12.00	10.20	9.25	10.75	9.69	9.25	13.75	20.30	14.00	14.75
April	14.31	13.75	13.00	11.75	9.50	9.25	10.40	9.25	9.25	14.50	20.19	14.50	16.87
May	14.25	14.00	12.81	11.68	9.50	9.50	10.50	8.75	9.37	14.56	19.75	13.85	18.35
June	14.75	13.75	12.81	11.50	9.61	10.12	10.32	8.75	9.30	16.00	18.75	13.37	20.19
July	14.75	13.75	12.40	11.37	9.75	11.50	9.75	8.95	9.25	17.56	16.81	13.00	20.75
Aug.	14.75	13.50	12.17	11.05	9.80	11.50	9.37	9.00	9.37	18.35	14.25	13.00	23.06
Sept.	14.25	13.50	12.00	10.75	10.00	12.75	9.50	9.35	9.55	19.94	13.62	13.06	25.00
Oct.	14.25	13.75	12.25	10.75	10.00	12.75	9.95	9.50	9.75	20.75	12,87	13.75	25.65
Nov.	14.25	14.00	12.50	10.75	9.75	12.75	10.44	9.50	9.75	20.75	12,95	14.00	23.62
Dec.	14.00	13.75	12.50	10.87	9.25	12.50	10.35	9.50	9.90	20.75	13.75	14.25	22.44

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Jan.	$21.65	$12.37	$16.25	$16.75	$26.00	$16.15	$16.25	$17.25	$14.25	$13.25	$16.95	$13.85	$12.40
Feb.	21.50	12.12	16.25	16.75	26.00	15.75	16.13	17.06	14.25	13.31	16.69	13.81	12.40
March	21.37	12.10	16.25	16.65	26.00	15.50	15.05	16.30	14.25	13.50	16.31	14.00	12.27
April	20.15	12.50	16.25	16.63	25.06	15.20	14.25	15.37	14.25	13.75	15.65	13.80	12.34
May	18.87	12.25	15.81	16.75	24.25	14.75	14.50	15.00	13.95	14.15	14.94	13.75	12.40
June	17.75	11.80	14.65	16.44	24.10	15.25	14.70	14.85	13.44	14.25	14.06	13.37	12.50
July	16.15	11.81	13.94	16.06	23.85	15.00	15.75	14.75	13.25	14.70	13.75	13.30	12.71
Aug.	15.19	12.00	14.40	17.30	23.00	15.25	16.38	14.31	13.45	15.06	14.06	13.25	13.71
Sept.	14.75	12.00	14.37	18.69	21.50	15.65	17.35	14.25	13.31	15.87	14.25	13.25	14.15
Oct.	13.50	12.81	15.31	20.00	20.95	15.75	17.88	14.25	13.25	16.80	14.35	12.90	14.78
Nov.	12.00	15.19	16.60	23.38	19.50	16.00	17.75	14.25	13.20	17.25	13.87	12.90	16.15
Dec.	12.05	15.85	16.75	25.00	17.00	16.25	17.45	14.25	13.19	17.25	13.95	12.50	17.10

Local No. 2 Foundry Pig Iron at Chicago (at Furnace after 1907), per Gross Ton

	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
Jan.	$19.00	$16.00	$19.50	$14.60	$14.50	$13.37	$12.50	$9.75	$13.55	$11.02	$11.35	$11.47	$23.85	$15.10
Feb.	18.87	15.00	18.87	15.00	14.37	12.81	11.87	9.75	12.50	11.00	11.28	12.47	23.85	14.60
March	18.12	15.00	17.62	15.00	14.00	13.00	11.30	9.81	12.00	10.88	11.10	14.95	23.85	15.60
April	17.50	15.00	16.62	15.12	14.00	13.00	10.50	10.25	12.00	10.75	11.26	15.47	23.72	15.85
May	17.00	15.00	16.20	15.00	14.00	12.96	10.50	10.25	11.69	10.38	11.35	15.72	22.65	15.85
June	16.25	14.50	16.00	15.00	14.00	13.00	10.50	10.88	11.50	10.25	11.35	17.95	20.72	15.35
July	16.00	14.87	16.00	15.15	14.00	12.79	10.12	12.13	11.25	10.25	11.35	19.22	18.60	15.35
Aug.	16.00	15.10	16.00	15.00	13.75	12.75	10.00	13.20	11.18	10.25	11.35	20.65	16.25	15.35
Sept.	16.50	15.50	16.00	15.00	13.50	12.75	10.00	13.63	10.75	10.40	11.35	22.22	15.35	15.35
Oct.	17.12	17.00	16.00	15.00	13.50	12.75	10.00	14.00	10.88	11.00	11.35	23.35	14.85	15.10
Nov.	17.00	17.62	15.75	14.94	13.50	12.75	9.70	14.00	11.19	11.00	11.35	23.45	14.85	15.23
Dec.	16.87	18.66	15.37	14.62	13.50	11.69	9.75	14.00	11.25	11.00	11.35	23.85	15.10	15.85

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Jan.	$16.25	$23.45	$14.47	$17.85	$19.60	$25.85	$18.45	$17.35	$19.00	$15.50	$14.00	$17.90	$13.80	$13.00
Feb.	16.85	23.35	13.91	17.85	19.41	25.85	18.16	16.75	19.00	15.50	14.00	17.31	14.00	13.00
March	18.51	23.22	14.05	17.80	19.35	26.10	17.85	16.50	18.30	15.50	14.00	17.25	14.25	12.95
April	18.97	22.87	14.35	17.60	19.10	26.35	17.73	16.50	17.50	15.00	14.00	17.06	14.25	13.00
May	20.85	20.72	13.85	17.60	18.90	26.85	17.63	16.50	17.06	15.00	14.50	16.15	14.06	13.00
June	21.85	19.85	13.70	17.00	18.54	26.60	17.73	16.50	16.75	15.00	14.50	15.63	13.69	13.00
July	21.60	18.25	13.60	16.47	18.60	25.55	17.55	17.00	16.56	14.87	14.70	14.70	13.75	13.00
Aug.	22.10	17.22	13.60	16.60	19.45	24.85	17.35	17.13	16.50	14.50	15.37	15.00	13.69	13.44
Sept.	23.35	16.41	13.85	16.60	20.16	24.10	17.05	18.70	16.40	14.50	16.00	15.00	13.31	13.90
Oct.	23.35	15.70	14.10	17.66	21.48	22.45	16.85	19.00	16.06	14.46	17.00	15.00	12.94	14.63
Nov.	23.35	15.10	15.98	19.15	24.70	20.66	17.10	19.00	16.00	14.09	17.75	14.88	12.56	17.13
Dec.	23.35	14.81	16.95	19.60	25.85	18.80	17.35	19.00	16.00	14.00	18.00	14.50	12.90	18.10

The Cincinnati prices given above date back to the earliest period for which Southern pig-iron quotations are available at that point. It may be said that these quotations represent almost the beginning of the Northern business in pig iron coming from the vicinity of Birmingham, Ala.

The Chicago prices also represent quotations from the beginning of the production of pig iron in the vicinity of Chicago for the merchant trade. For a long time these prices were quoted delivered on track near Chicago foundries, but beginning in 1908 prices were figured at the furnace, from which at that time a switching charge to local foundries of about 35 cents per ton applied. At the present time the switching charge averages about 50 cents.

The Goodyear Tire & Rubber Company, Akron, Ohio, announces the establishment of a plan of retirement awards, making provision for stated monthly payments for life to men who have reached the age of 70 and women who have reached 65, and there is also a condition under which old employees may retire, with awards, under the age limits mentioned. It also gives any one on its payroll an insurance policy for $1,000, free of all cost, provided the employee is or becomes a member of the Goodyear Relief Association, which is an institution of long standing.

The Commonwealth Steel Company, St. Louis, which has been operating a school for its employees, has found the day school a decided success while the night school failed to accomplish results. Employees attend the day school four hours each week and study on the company's time, being paid at their regular wage rate therefor. There are nine sessions each week, and about 100 students, averaging 22 years old, are attending. Mechanical drawing, mathematics, spelling, reading and writing are taught in classes, while considerable individual instruction is also given.

L. S. Charcoal Pig-Iron Prices for 27 Years

The following table, which has been compiled from quotations in THE IRON AGE, gives the average monthly prices of Lake Superior charcoal pig iron per gross ton, in carload lots, at Chicago, from 1889 to 1915.

	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
Jan.	$20.00	$23.00	$18.50	$17.25	$16.50	$15.50	$13.00	$14.50	$13.50	$12.50	$11.50	$25.50	$19.00	$19.25
Feb.	19.50	23.00	18.25	17.00	16.50	15.40	13.00	14.00	13.50	11.50	12.50	25.50	17.50	20.25
March	19.50	22.50	18.00	17.00	16.50	15.25	13.00	13.50	13.50	11.50	15.75	25.50	17.50	20.65
April	19.25	21.50	18.00	16.75	16.50	15.25	12.75	13.50	13.50	11.50	17.00	25.50	18.00	21.50
May	18.75	20.50	17.00	16.50	16.50	15.25	13.00	13.50	13.00	11.50	17.25	24.50	17.50	22.80
June	18.50	20.50	16.75	16.50	16.00	15.25	13.00	13.50	13.00	11.50	19.50	23.00	17.00	23.50
July	18.50	20.00	17.00	16.50	16.00	15.00	13.50	13.50	13.00	11.50	21.50	22.00	17.00	25.00
Aug.	18.50	20.25	17.00	16.50	16.00	14.50	13.50	13.50	13.00	11.50	22.50	20.00	17.00	25.75
Sept.	18.75	20.25	17.25	16.50	16.00	14.25	14.50	13.50	12.50	11.50	24.25	18.50	17.00	26.00
Oct.	19.50	19.75	17.00	16.75	16.00	14.00	15.50	13.50	12.50	11.50	25.00	18.00	17.00	26.00
Nov.	20.00	19.25	17.00	16.50	15.75	13.50	15.50	13.50	12.50	11.50	25.50	17.00	17.50	26.00
Dec.	22.00	18.75	16.75	16.50	15.50	13.00	16.00	13.50	12.50	11.50	25.50	18.25	18.00	25.25

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Jan.	$25.60	$16.62	$18.50	$20.40	$26.80	$22.50	$19.50	$19.50	$17.87	$16.00	$18.15	$15.25	$15.75
Feb.	26.50	15.87	18.50	20.13	27.00	21.38	19.50	19.50	17.50	15.95	18.00	15.25	15.75
March	26.50	15.00	18.50	19.75	26.75	21.25	19.50	19.30	17.50	15.75	18.00	15.25	15.75
April	25.30	15.19	18.50	19.44	26.50	20.30	19.50	19.00	17.50	15.75	18.00	15.45	15.75
May	24.12	15.00	17.75	19.05	27.40	20.00	19.50	18.62	17.25	15.75	18.00	15.75	15.75
June	24.00	14.70	17.00	19.00	27.50	20.00	19.50	18.50	16.80	16.75	16.81	15.75	15.75
July	22.20	14.50	16.50	19.06	27.00	20.00	19.50	18.50	16.50	16.25	15.65	15.75	15.75
Aug.	20.62	14.87	16.40	19.35	27.20	19.50	19.50	18.50	16.50	16.25	14.69	15.75	16.00
Sept.	19.00	14.75	16.87	20.13	27.00	19.50	19.50	18.40	16.50	17.12	15.25	15.75	15.85
Oct.	18.10	15.31	18.25	21.50	26.20	19.50	19.50	18.12	16.50	18.65	15.25	15.75	15.75
Nov.	17.12	16.37	19.20	24.63	25.12	19.50	19.50	18.00	16.50	18.65	15.25	15.75	17.00
Dec.	16.50	17.80	20.00	26.13	24.25	19.50	19.50	18.00	16.37	18.75	15.25	15.75	18.65

Billet Prices at Pittsburgh for Thirty Years

The table below gives the average monthly prices of 4 x 4 in. Bessemer steel billets at Pittsburgh from 1886 to 1915, inclusive. The prices are per gross ton and are averaged from weekly quotations in THE IRON AGE. Prior to 1886 steel billets were not a regular merchant commodity.

	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
Jan.	$33.00	$24.50	$29.38	$28.15	$36.65	$25.60	$25.00	$21.56	$16.12	$14.90	$16.80	$15.42	$14.93	$16.62	$34.50
Feb.	33.13	35.44	29.38	27.81	35.25	26.00	24.36	21.62	15.75	14.95	17.38	15.25	15.06	18.60	34.87
March	33.00	36.00	29.13	27.25	31.88	26.25	23.00	22.60	15.55	14.84	17.09	15.44	15.25	24.30	23.00
April	32.00	34.75	28.63	27.00	28.38	25.35	22.81	22.44	15.69	15.44	19.53	14.60	15.06	25.37	32.00
May	30.50	32.38	28.35	26.90	27.55	25.50	22.41	21.69	18.00	16.30	19.50	13.82	14.85	26.75	28.90
June	30.75	31.40	28.06	26.75	30.25	25.25	22.97	21.70	18.12	18.63	19.12	14.06	14.65	30.10	27.25
July	30.33	31.50	28.00	27.13	30.70	25.50	23.50	21.06	18.00	20.75	18.85	14.00	14.50	33.12	21.00
Aug.	30.00	32.50	28.40	28.20	30.38	25.31	23.81	20.45	17.15	21.75	18.75	14.00	15.85	35.40	18.20
Sept.	30.50	31.80	29.00	29.50	30.13	25.00	23.65	19.31	17.19	24.00	19.75	15.60	16.00	38.37	16.93
Oct.	31.63	31.63	29.25	33.70	28.70	24.90	23.53	18.06	16.00	21.90	19.75	16.44	15.56	38.75	16.50
Nov.	32.00	31.00	29.00	34.00	27.39	24.16	24.94	17.37	15.57	19.13	20.00	15.57	15.06	36.50	18.95
Dec.	32.90	29.00	28.44	35.60	26.25	24.20	22.40	16.69	15.12	16.97	17.50	15.00	15.80	33.75	19.75

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Jan.	$19.75	$27.50	$29.60	$23.00	$22.75	$26.25	$29.40	$28.00	$25.00	$27.50	$23.00	$20.00	$28.30	$20.13	$19.25
Feb.	20.31	29.37	29.87	23.00	23.50	26.50	29.50	28.00	25.00	27.50	23.00	20.00	28.50	21.00	19.50
March	22.88	31.25	30.62	23.00	24.00	26.70	29.00	28.00	23.00	27.50	23.00	19.75	28.50	21.00	19.70
April	24.00	31.50	30.25	23.00	24.00	27.00	30.12	28.00	23.00	26.75	23.00	20.00	28.50	20.80	20.00
May	24.00	32.20	30.37	23.00	23.50	26.40	30.30	28.00	23.00	26.12	22.60	20.80	27.60	20.00	20.00
June	24.38	32.37	28.87	23.00	22.00	26.63	29.62	25.75	23.00	25.30	21.00	20.87	26.50	19.50	20.50
July	24.00	31.75	27.60	23.00	22.00	27.25	30.00	25.00	23.50	25.00	21.00	21.50	26.60	19.00	21.38
Aug.	24.20	31.06	27.00	23.00	24.00	27.80	29.25	25.00	24.13	24.62	21.00	22.12	26.00	20.25	23.13
Sept.	24.88	29.50	27.00	20.00	25.00	28.00	29.37	25.00	25.00	24.40	20.75	23.62	24.87	21.00	24.10
Oct.	26.70	29.70	27.00	19.50	25.62	28.00	28.20	25.00	26.25	23.75	20.00	26.00	23.30	20.00	24.63
Nov.	27.00	28.50	24.00	20.25	26.00	28.88	28.00	25.00	27.13	23.30	19.50	27.00	21.00	19.25	26.50
Dec.	27.50	29.12	23.00	21.20	26.00	29.50	28.00	25.00	27.50	23.00	19.25	27.00	20.00	19.00	30.25

Heavy Melting Steel Scrap Prices, Pittsburgh

The appended table gives the average monthly prices of heavy melting steel scrap at Pittsburgh for 15 years, comprising 1901 to 1915, inclusive. These prices are per gross ton and are averaged from weekly quotations in the Pittsburgh iron market report of THE IRON AGE.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
Jan.	$13.00	$17.40	$21.20	$12.50	$16.25	$17.25	$18.95	$12.80	$16.63	$17.69	$13.50	$12.75	$14.95	$13.62	$11.63
Feb.	14.50	17.63	21.13	13.50	15.88	16.31	18.06	13.88	15.63	17.25	14.13	12.12	14.19	12.62	11.63
March	16.00	18.50	21.00	14.00	15.90	14.70	18.00	13.19	14.19	16.80	14.35	12.62	14.19	12.12	12.00
April	16.50	19.00	21.50	13.63	16.00	14.75	17.94	12.80	14.00	16.50	13.06	13.06	14.19	12.00	11.81
May	17.00	20.00	21.25	12.13	15.00	14.80	18.10	12.81	14.81	15.30	12.62	13.25	13.55	12.00	11.75
June	17.50	21.25	20.00	11.30	13.90	15.63	18.38	13.13	15.69	15.10	12.95	13.44	12.62	12.00	11.75
July	17.00	21.90	19.70	10.75	14.00	15.75	18.06	14.25	15.90	14.50	13.06	13.34	12.40	12.00	12.31
Aug.	16.00	21.00	18.50	11.38	14.85	16.50	17.75	14.81	16.31	14.31	13.20	13.55	12.37	11.50	13.81
Sept.	15.00	21.50	17.25	11.50	15.88	16.88	17.38	14.25	17.40	14.35	12.50	14.11	12.25	11.31	14.30
Oct.	17.50	21.50	15.30	12.25	16.50	17.13	17.10	15.20	17.94	14.25	12.06	15.85	11.85	10.85	14.38
Nov.	18.00	21.00	13.25	14.25	17.50	18.00	14.88	16.06	17.50	14.25	12.00	15.12	11.44	10.00	15.88
Dec.	17.50	21.00	11.20	16.20	17.63	20.00	13.00	16.70	18.00	13.75	12.31	14.75	11.06	10.75	17.45

Koppers Coke-Oven Plant at St. Paul

The H. Koppers Company, First National Bank Building, Pittsburgh, has received a contract from the Western States Coke Company, Minneapolis, Minn., for the erection at or near St. Paul of fifty-five 12¼-ton cross regenerative Koppers by-product coke ovens, including benzol apparatus. The Koppers Company will build the plant complete, including foundations, coal and coke handling machinery, storage and other departments. The coke will be sold for domestic use in St. Paul and Minneapolis. The ninety-four by-product coke ovens which it is building for the Toledo Furnace Company, Toledo, Ohio, will be finished about April 15, and will include apparatus to have a capacity of about 6000 gal. of benzol per day, the contract for which has just been awarded.

N. E. Cook, president and treasurer, announces the retirement from active business of the Cook Well Company, St. Louis, manufacturer of well tools, after a career of thirty-four years. The manufacture of the Cook products will be carried on by A. D. Cook at Lawrenceburg, Ind.

Metal, Tin-Plate and Sheet Prices for Eighteen Years

Monthly Averages Computed from the Weekly Market Quotations of "The Iron Age" in the Period of 1898-1915

(With Supplement)

The accompanying supplement shows by plotted lines the fluctuations in prices of the more important metals, tin plate and sheets in the period from 1898 to 1915, inclusive. The prices used for this purpose are the computed monthly averages of the prices of carloads, at New York, for metals and at Pittsburgh for tin plate and No. 28 black steel sheets, given in the metal market reports of THE IRON AGE week by week. The columns of figures alongside the chart give the values. The column nearest the chart gives tin in cents per pound; the middle column, copper in cents per pound, and the outside column represents lead, spelter and steel sheets in cents per pound and tin plate in dollars per base box. The following tables give the monthly averages on which the chart is based:

Lake Copper, at New York, in Cents per Pound

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915
January	11.00	14.02	16.21	16.90	11.45	12.13	12.62	15.18	18.78	24.41	13.90	14.56	14.00	12.81	14.50	16.98	14.85	14.02
February	11.19	17.66	16.25	16.97	12.47	12.80	12.34	15.25	17.94	25.10	13.13	13.37	13.78	12.75	14.41	15.55	15.00	15.21
March	11.95	17.55	16.41	17.00	12.12	14.31	12.60	15.25	18.50	23.38	12.85	12.90	13.75	12.58	14.88	15.05	14.79	15.75
April	12.05	18.56	17.00	17.00	11.97	14.85	13.19	15.18	18.62	24.62	13.09	12.94	13.31	12.41	16.00	15.67	14.75	18.90
May	12.04	18.65	16.80	17.00	12.10	14.75	13.28	15.00	18.70	24.10	12.88	13.21	13.06	12.33	16.30	15.91	14.40	21.00
June	11.85	18.20	16.31	17.00	12.23	14.56	12.74	15.00	18.69	23.94	13.00	13.50	12.88	12.71	17.53	15.42	14.12	22.38
July	11.59	18.37	16.31	16.97	11.94	13.73	12.62	15.03	18.47	21.95	13.00	13.34	12.66	12.78	17.54	14.78	13.70	21.98
August	11.85	18.50	16.55	16.50	11.59	13.35	12.50	16.07	18.65	18.94	13.71	13.56	12.93	12.75	17.73	15.86	12.86	19.33
September	13.25	18.47	16.75	16.50	11.60	13.58	12.67	16.12	19.31	16.41	13.80	13.50	12.81	12.65	17.77	16.77	12.66	17.97
October	12.37	18.03	16.73	16.71	11.71	13.42	13.09	16.62	21.81	13.80	13.81	13.19	12.84	12.53	17.80	16.85	11.73	17.89
November	12.69	17.00	16.75	16.82	11.44	13.25	14.22	16.90	22.50	13.94	14.44	13.44	12.98	12.80	17.70	16.16	12.00	18.92
December	12.79	16.69	16.87	14.71	11.61	12.30	14.87	18.75	23.06	13.48	14.53	13.80	13.00	13.84	17.69	14.88	13.35	20.24

Spelter, at New York, in Cents per Pound

January	3.75	4.90	4.55	4.08	4.28	4.82	4.95	6.17	6.48	6.90	4.54	5.15	6.26	5.55	6.52	7.15	5.29	6.59
February	3.79	5.68	4.69	3.94	4.18	5.00	4.95	6.12	6.09	7.00	4.78	4.99	5.89	5.56	6.71	6.45	5.40	8.84
March	4.00	5.99	4.60	3.89	4.29	5.36	5.05	6.06	5.96	6.92	4.76	4.81	5.72	5.65	6.98	6.26	5.28	9.29
April	4.00	6.25	4.71	3.94	4.41	5.65	5.22	5.97	6.05	6.81	4.68	4.94	5.60	5.51	6.86	5.77	5.18	11.22
May	3.95	6.72	4.52	3.97	4.50	5.75	5.14	5.55	5.95	6.51	4.60	5.12	5.20	5.50	6.86	5.47	5.06	16.14
June	4.65	6.02	4.27	3.95	4.88	6.00	4.79	5.32	6.14	6.45	4.56	5.39	5.19	5.63	6.99	5.18	5.09	22.18
July	4.51	5.79	4.24	3.90	5.23	5.95	4.85	5.38	5.98	6.15	4.46	5.35	5.20	5.70	7.26	5.38	5.02	20.58
August	4.35	5.55	4.17	3.92	5.46	5.94	4.85	5.66	6.06	5.71	4.71	5.74	5.26	6.04	7.19	5.75	5.60	14.11
September	4.62	5.40	4.10	4.02	5.45	6.00	5.06	5.83	6.19	5.28	4.76	5.85	5.53	6.03	7.53	5.82	5.50	14.16
October	4.61	5.37	4.10	4.20	5.48	6.05	5.17	6.05	6.18	5.45	4.81	6.09	5.69	6.20	7.57	5.42	4.97	13.96
November	5.09	4.64	4.20	4.32	5.29	5.68	5.49	6.17	6.36	5.10	5.03	6.32	5.95	6.60	7.48	5.29	5.12	17.15
December	5.13	4.68	4.19	4.35	4.91	5.15	5.80	6.50	6.62	4.39	5.17	6.35	5.80	6.44	7.33	5.18	5.71	16.69

Lead, at New York, in Cents per Pound

January	3.66	4.02	4.70	4.37	4.02	4.10	4.39	4.56	5.86	6.30	3.73	4.19	4.70	4.50	4.41	4.35	4.11	3.74
February	3.69	4.53	4.70	4.37	4.10	4.10	4.40	4.50	5.56	6.31	3.75	4.07	4.63	4.46	4.00	4.35	4.06	3.82
March	3.71	4.37	4.70	4.37	4.10	4.44	4.50	4.45	5.35	6.31	3.88	4.02	4.51	4.41	4.08	4.35	3.97	4.04
April	3.61	4.30	4.70	4.37	4.10	4.59	4.50	4.50	5.39	6.16	4.02	4.19	4.40	4.44	4.20	4.40	3.82	4.20
May	3.64	4.42	4.22	4.37	4.10	4.37	4.48	4.50	5.90	6.02	4.26	4.32	4.37	4.40	4.20	4.37	3.90	4.25
June	3.86	4.45	3.90	4.37	4.10	4.25	4.22	4.51	5.94	5.75	4.45	4.36	4.38	4.46	4.50	4.35	3.90	5.89
July	3.95	4.55	4.03	4.37	4.10	4.12	4.17	4.56	5.80	5.24	4.50	4.35	4.40	4.50	4.67	4.37	3.90	5.59
August	3.99	4.56	4.26	4.37	4.10	4.12	4.15	4.64	5.78	5.12	4.59	4.36	4.40	4.50	4.54	4.64	3.87	4.68
September	3.99	4.60	4.36	4.37	4.10	4.26	4.20	4.85	5.92	4.84	4.54	4.39	4.40	4.49	5.04	4.73	3.86	4.62
October	3.81	4.59	4.37	4.37	4.10	4.40	4.20	5.07	5.94	4.64	4.34	4.39	4.40	4.31	5.06	4.52	3.52	4.60
November	3.70	4.58	4.37	4.37	4.10	4.25	4.51	5.48	5.97	4.45	4.39	4.40	4.44	4.31	4.66	4.33	3.68	5.16
December	3.62	4.65	4.37	4.19	4.10	4.19	4.60	5.96	6.19	3.76	4.24	4.56	4.50	4.45	4.32	4.06	3.80	5.33

Tin, at New York, in Cents per Pound

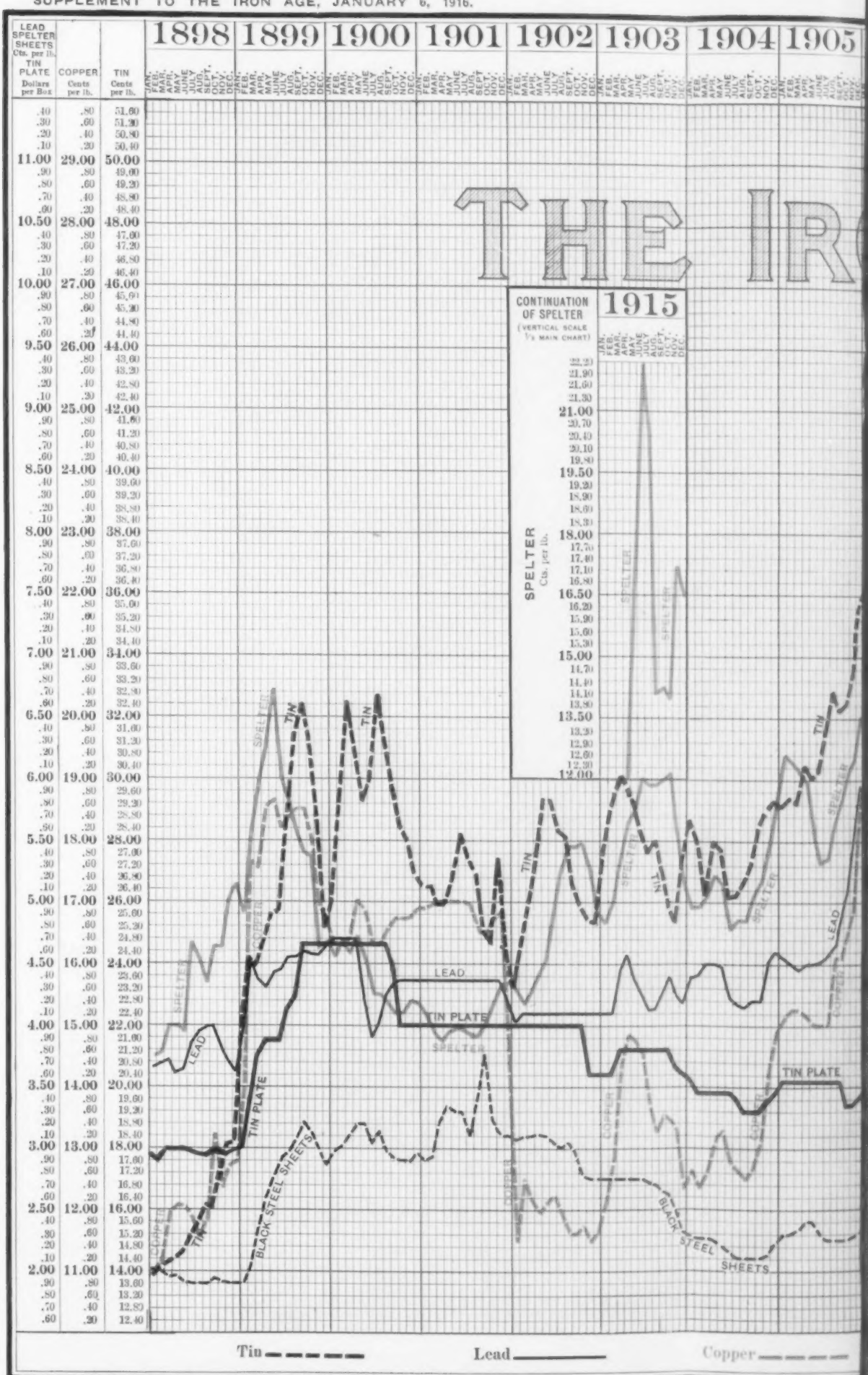
January	13.77	22.12	26.00	26.60	23.38	27.76	28.75	29.18	36.36	42.14	27.43	28.19	32.61	41.20	44.58	50.34	30.12	34.13
February	14.04	24.25	29.71	26.55	24.73	29.14	27.98	29.49	36.48	42.16	28.74	28.44	32.65	43.34	43.56	48.71	39.82	37.25
March	14.26	23.86	32.42	25.95	26.16	30.06	26.19	29.21	36.62	41.29	30.46	28.75	32.51	41.10	42.76	46.93	38.03	48.73
April	14.41	24.82	30.85	25.94	27.29	29.69	27.99	30.43	38.86	40.84	31.79	29.35	32.83	42.05	43.64	49.04	36.10	47.64
May	14.54	25.61	29.25	26.82	29.26	29.36	27.76	30.04	43.08	43.01	29.84	29.07	33.05	43.32	45.98	49.06	33.21	38.79
June	15.05	25.69	30.00	28.22	29.29	28.30	28.14	30.36	38.97	42.65	28.18	29.26	32.70	46.25	47.44	45.01	30.60	40.26
July	15.60	28.72	32.76	27.41	28.28	27.60	26.28	31.71	37.18	41.15	28.92	29.05	32.99	43.23	44.70	41.32	35.65	37.38
August	16.14	31.40	31.13	26.90	28.14	28.00	26.74	32.85	39.90	37.35	29.99	29.96	33.92	43.38	45.86	41.63	48.34	34.37
September	16.02	32.40	29.63	25.04	26.55	27.06	27.27	32.21	40.32	37.22	28.91	30.00	35.17	39.69	49.16	42.63	31.13	33.13
October	17.25	31.35	28.46	24.62	25.76	25.83	28.53	32.47	42.90	32.33	29.44	30.41	36.76	41.23	50.07	40.38	30.25	33.05
November	18.07	28.52	28.10	27.47	25.43	25.35	29.00	33.46	42.70	30.81	30.43	30.74	37.38	43.08	49.87	39.75	33.28	39.50
December	18.20	25.19	26.84	24.39	25.33	27.53	29.27	35.84	42.62	27.92	29.13	32.91	38.21	45.03	49.86	37.12	34.01	38.53

Tin Plate, at Pittsburgh, in Dollars per Box

January	$2.95	$3.00	$4.65	$4.00	$4.00	$3.60	$3.56	$3.55	$3.47	$3.90	$3.74	$3.70	$3.60	$3.60	$3.40	$3.60	$3.32	$3.10
February	2.90	3.38	4.65	4.00	4.00	3.60	3.45	3.55	3.50	3.90	3.70	3.70	3.60	3.67	3.35	3.60	3.29	3.10
March	3.00	3.75	4.65	4.00	4.00	3.80	3.45	3.55	3.50	3.90	3.70	3.53	3.60	3.70	3.30	3.60	3.30	3.25
April	3.00	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.57	3.90	3.70	3.40	3.60	3.70	3.30	3.60	3.30	3.25
May	3.00	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.66	3.90	3.70	3.40	3.60	3.70	3.33	3.60	3.30	3.15
June	2.99	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.40	3.60	3.30	3.11
July	2.94	4.12	4.65	4.00	4.00	3.80	3.41	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.43	3.60	3.27	3.10
August	2.93	4.23	4.65	4.00	4.00	3.80	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.50	3.55	3.41	3.10
September	2.98	4.65	4.50	4.00	4.00	3.80	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.67	3.58	3.50	3.35	3.15
October	2.98	4.65	4.00	4.00	4.00	3.80	3.30	3.34	3.75	3.90	3.70	3.50	3.60	3.52	3.60	3.50	3.24	3.15
November	2.98	4.65	4.00	4.00	3.60	3.65	3.39	3.34	3.90	3.90	3.70	3.56	3.60	3.40	3.60	3.40	3.15	3.28
December	3.00	4.65	4.00	4.00	3.60	3.60	3.47	3.40	3.90	3.90	3.70	3.60	3.60	3.40	3.60	3.40	3.13	3.52

No. 28 Black Steel Sheets, at Pittsburgh, in Cents per Pound

January	2.02½	1.92½	2.97½	2.90	3.07½	2.75	2.29	2.30	2.40	2.60	2.52	2.50	2.40	2.20	1.90	2.31	1.87	1.80
February	2.00	2.05	3.03	2.93¾	3.10	2.75	2.27½	2.30	2.40	2.60	2.50	2.50	2.40	2.20	1.87	2.35	1.95	1.80
March	1.96	2.36	3.10	3.22½	3.10	2.75	2.27	2.34	2.38	2.60	2.50	2.25	2.40	2.20	1.80	2.35	1.95	1.80
April	1.97½	2.60	3.20	3.35	3.12½	2.75	2.25	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.86	2.35	1.91	1.80
May	1.92½	2.78¾	3.20	3.30	3.10	2.75	2.20	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.90	2.30	1.85	1.79
June	1.90	2.93	3.05	3.30	3.05	2.75	2.16	2.30	2.50	2.60	2.50	2.20	2.40	2.00	1.90	2.27	1.81	1.75
July	1.90	2.97½	3.14¼	3.10	3.00	2.73¾	2.10	2.26	2.50	2.60	2.50	2.20	2.23¾	2.00	1.95	2.25	1.80	1.75
August	1.90	3.08	2.98	3.41	3.05	2.70	2.10	2.26	2.50	2.60	2.50	2.20	2.21	1.99	2.02	2.21	1.86	1.85
September	1.96	3.22½	2.93¾	3.77½	2.97½	2.65	2.10	2.25	2.50	2.60	2.50	2.26	2.15	1.91	2.07	2.14	1.95	1.90
October	1.92	3.15	2.90	3.23	2.79	2.62	2.10	2.25	2.50	2.60	2.50	2.30	2.20	1.85	2.21	2.04	1.94	2.03
November	1.90	3.00	2.89	3.10	2.75	2.49	2.12½	2.27	2.60	2.60	2.50	2.30	2.20	1.85	2.25	1.97	1.87	2.25
December	1.90	2.87½	2.96	3.10	2.75	2.32	2.22	2.30	2.60	2.60	2.50	2.40	2.19	1.83¾	2.25	1.89	1.82	2.50

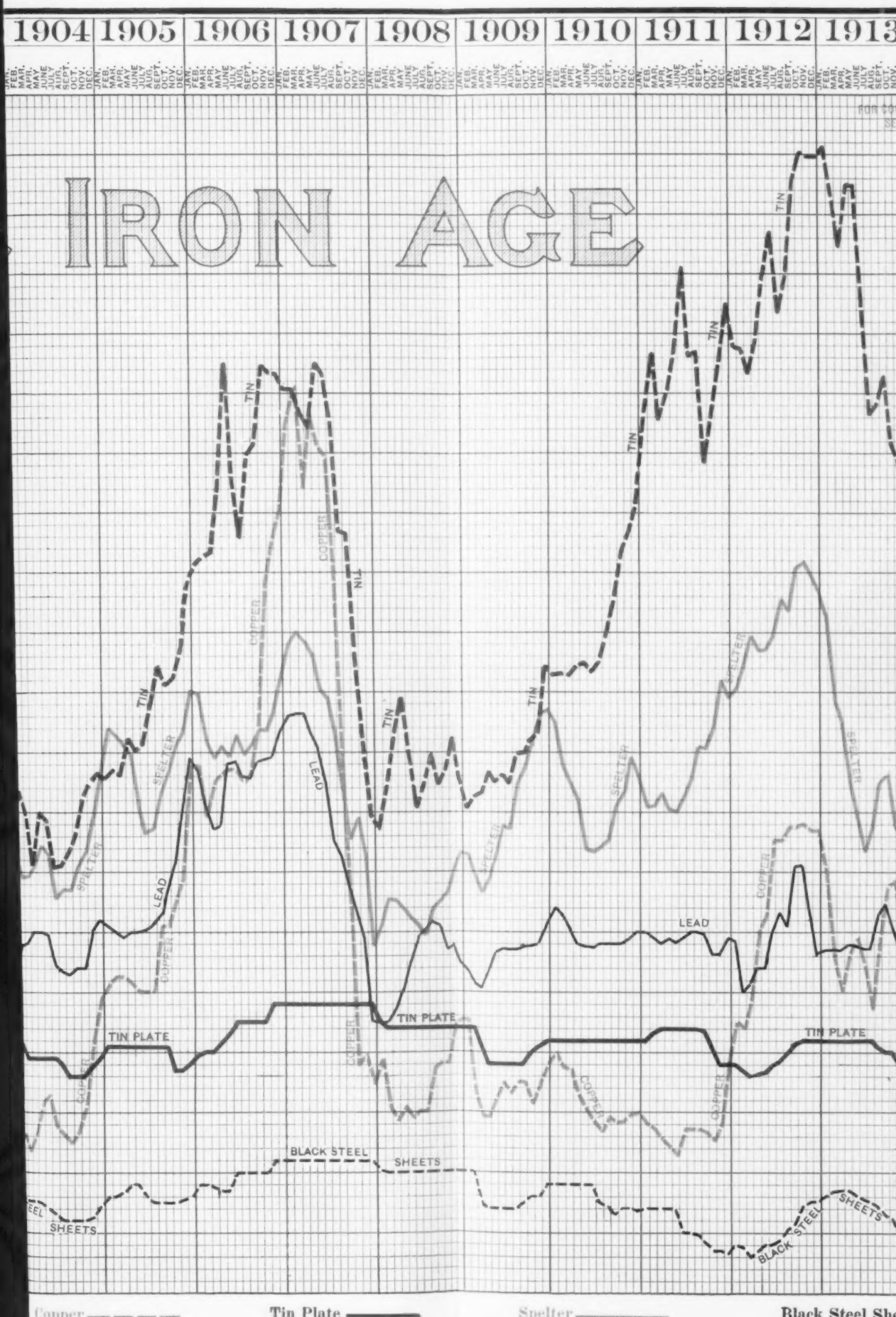


LEAD SPELTER SHEETS Cts. per lb.	COPPER Cents per lb.	TIN Cents per lb.	TIN PLATE Dollars per Box
	.80	51.60	.40
	.60	51.20	.30
	.40	50.80	.20
	.20	50.40	.10
	29.00	50.00	11.00
	.80	49.60	.90
	.60	49.20	.80
	.40	48.80	.70
	.20	48.40	.60
	28.00	48.00	10.50
	.80	47.60	.40
	.60	47.20	.30
	.40	46.80	.20
	.20	46.40	.10
	27.00	46.00	10.00
	.80	45.60	.90
	.60	45.20	.80
	.40	44.80	.70
	.20	44.40	.60
	26.00	44.00	9.50
	.80	43.60	.40
	.60	43.20	.30
	.40	42.80	.20
	.20	42.40	.10
	25.00	42.00	9.00
	.80	41.60	.90
	.60	41.20	.80
	.40	40.80	.70
	.20	40.40	.60
	24.00	40.00	8.50
	.80	39.60	.40
	.60	39.20	.30
	.40	38.80	.20
	.20	38.40	.10
	23.00	38.00	8.00
	.80	37.60	.90
	.60	37.20	.80
	.40	36.80	.70
	.20	36.40	.60
	22.00	36.00	7.50
	.80	35.60	.40
	.60	35.20	.30
	.40	34.80	.20
	.20	34.40	.10
	21.00	34.00	7.00
	.80	33.60	.90
	.60	33.20	.80
	.40	32.80	.70
	.20	32.40	.60
	20.00	32.00	6.50
	.80	31.60	.40
	.60	31.20	.30
	.40	30.80	.20
	.20	30.40	.10
	19.00	30.00	6.00
	.80	29.60	.90
	.60	29.20	.80
	.40	28.80	.70
	.20	28.40	.60
	18.00	28.00	5.50
	.80	27.60	.40
	.60	27.20	.30
	.40	26.80	.20
	.20	26.40	.10
	17.00	26.00	5.00
	.80	25.60	.90
	.60	25.20	.80
	.40	24.80	.70
	.20	24.40	.60
	16.00	24.00	4.50
	.80	23.60	.40
	.60	23.20	.30
	.40	22.80	.20
	.20	22.40	.10
	15.00	22.00	4.00
	.80	21.60	.90
	.60	21.20	.80
	.40	20.80	.70
	.20	20.40	.60
	14.00	20.00	3.50
	.80	19.60	.40
	.60	19.20	.30
	.40	18.80	.20
	.20	18.40	.10
	13.00	18.00	3.00
	.80	17.60	.90
	.60	17.20	.80
	.40	16.80	.70
	.20	16.40	.60
	12.00	16.00	2.50
	.80	15.60	.40
	.60	15.20	.30
	.40	14.80	.20
	.20	14.40	.10
	11.00	14.00	2.00
	.80	13.60	.90
	.60	13.20	.80
	.40	12.80	.70
	.20	12.40	.60

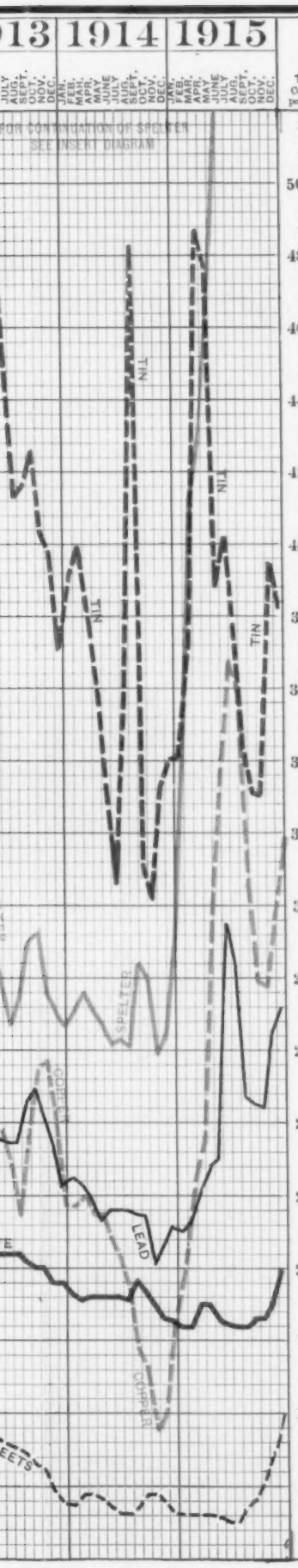
SPELTER Cts. per lb.
22.20
21.90
21.60
21.30
21.00
20.70
20.40
20.10
19.80
19.50
19.20
18.90
18.60
18.30
18.00
17.70
17.40
17.10
16.80
16.50
16.20
15.90
15.60
15.30
15.00
14.70
14.40
14.10
13.80
13.50
13.20
12.90
12.60
12.30
12.00

Tin – – – – – Lead ——— Copper — — — —

Fluctuations in Carload Prices of Lake Copp
No. 28 Black Steel Sheets in Pitts



ake Copper, Lead, Tin and Spelter in New York an
ts in Pittsburgh from January 1, 1898, to January 1,



TIN Cents per lb.	COPPER Cents per lb.	LEAD SPELTER SHEETS Cts. per lb. TIN PLATE Dollars per Box
51.60	.80	.40
51.20	.60	.30
50.80	.40	.20
50.40	.20	.10
50.00	**29.00**	**11.00**
49.60	.80	.90
49.20	.60	.80
48.80	.40	.70
48.40	.20	.60
48.00	**28.00**	**10.50**
47.60	.80	.40
47.20	.60	.30
46.80	.40	.20
46.40	.20	.10
46.00	**27.00**	**10.00**
45.60	.80	.90
45.20	.60	.80
44.80	.40	.70
44.40	.20	.60
44.00	**26.00**	**9.50**
43.60	.80	.40
43.20	.60	.30
42.80	.40	.20
42.40	.20	.10
42.00	**25.00**	**9.00**
41.60	.80	.90
41.20	.60	.80
40.80	.40	.70
40.40	.20	.60
40.00	**24.00**	**8.50**
39.60	.80	.40
39.20	.60	.30
38.80	.40	.20
38.40	.20	10
38.00	**23.00**	**8.00**
37.60	.80	.90
37.20	.60	.80
36.80	.40	.70
36.40	.20	.60
36.00	**22.00**	**7.50**
35.60	.80	.40
35.20	.60	.30
34.80	.40	.20
34.40	.20	10
34.00	**21.00**	**7.00**
33.60	.80	.90
33.20	.60	.80
32.80	.40	.70
32.40	.20	.60
32.00	**20.00**	**6.50**
31.60	.80	.40
31.20	.60	.30
30.80	.40	.20
30.40	.20	.10
30.00	**19.00**	**6.00**
29.60	.80	.90
29.20	.60	.80
28.80	.40	.70
28.40	.20	.60
28.00	**18.00**	**5.50**
27.60	.80	.40
27.20	.60	.30
26.80	.40	.20
26.40	.20	.10
26.00	**17.00**	**5.00**
25.60	.80	.90
25.20	.60	.80
24.80	.40	.70
24.40	.20	.60
24.00	**16.00**	**4.50**
23.60	.80	.40
23.20	.60	.30
22.80	.40	.20
22.40	.20	.10
22.00	**15.00**	**4.00**
21.60	.80	.90
21.20	.60	.80
20.80	.40	.70
20.40	.20	.60
20.00	**14.00**	**3.50**
19.60	.80	.40
19.20	.60	.30
18.80	.40	.20
18.40	.20	.10
18.00	**13.00**	**3.00**
17.60	.80	.90
17.20	.60	.80
16.80	.40	.70
16.40	.20	.60
16.00	**12.00**	**2.50**
15.60	.80	.40
15.20	.60	.30
14.80	.40	.20
14.40	.20	.10
14.00	**11.00**	**2.00**
13.60	.80	.90
13.20	.60	.80
12.80	.40	.70
12.40	.20	.60

el Sheets——————

and Tin Plate and
l, 1916

Metals and Alloys in the Steel Industry

A Review of Conditions in 1915—Tungsten the Spectacular Feature of the Market—Ferromanganese and Ferrosilicon

BY DE COURCY BROWNE*

Very few metallurgical advances were made in the metal and alloy industries during the year just past, largely because of the very high efficiency to which this business had already developed. The uses of the principal metals remained practically standard. The purity of such metals was not materially improved, for the reason that the specifications of users heretofore have been so stringent that manufacturers were compelled to produce metals and alloys technically free from all deleterious impurities.

On account of the war, many foreign sources of supply were cut off and for this reason and in order to supply our home demand it was necessary for American metal and alloy manufacturers not only to increase their present equipments, but also to manufacture materials for consumers heretofore supplied solely from abroad. This led to considerable confusion at first, on account of the great scramble for the necessary ores; but this situation is now almost completely under control, and while markets are high very satisfactory grades of raw materials are available under certain conditions.

It is hoped that these new industries are here to stay and for this reason the American steel maker will eventually have his reward, although at the present moment he is paying abnormal figures for his supplies.

ELECTROLYTIC FERROSILICON

Due to the heavy demands of the basic steel makers, the consumption of this very necessary alloy has been very heavy and it is scarcer than at any previous period. For many years the silicon market was stationary, and while the consumption increased steadily producers were always able to keep a very steady pace with consumers and there was practically no scarcity. It is also to be noted that manufacturers of silicon can readily equip themselves to produce carbide, so that if the silicon market should fall off these furnaces can be put on carbide very promptly.

Within the last six months, however, ferrosilicon prices have advanced approximately 20 per cent. It is understood that one of the leading Canadian producers, which has supplied the American market to quite an extent, now exports entirely to countries abroad so that this supply is entirely cut off from the American market and this has tended to increase the shortage here. Although large amounts of silicon were imported from Scandinavian countries before the war, this source of supply is now very largely discontinued.

FERROMANGANESE

The British embargo has had a decided effect on fluctuations of this metal which is the most commonly used in steel making. Before the war we produced very little 80 per cent ferromanganese in this country, apart from the operations of the largest steel producers, for the reason that supplies from abroad were abundant and the metal was offered here at remarkably low prices, quotations having been made as low as $35 to $40 per ton, seaboard which offered no inducement to American competition.

Since the war, however, and on account of the great scarcity and high prices of foreign material, several of the independent companies, notably the Jones & Laughlin Steel Company and the Maryland Steel Company, have turned some of their blast furnaces to manganese and considerable tonnages have been thus produced; also in California and at one eastern point high-grade 80 per cent ferromanganese has been produced in the electric furnace. With this increased American production, the price of this metal has been maintained for months around $100 but recently went to $110 in view of the continued high rate of steel production. At the beginning of the year British 80 per cent ferromanganese sold at $68.

FERROCHROME

Chromium is a very important alloying metal in tool steels, and in automobile and other special steels. It is produced electrolytically and by the Thermit process in this country. The highest grades of ores are imported principally from Turkey, New Caledonia and the Ural Mountains of Russia; also large deposits occur in Canada and the Far West, but owing to the difficulties in transportation, only small amounts of ores have been brought in from the first two sources.

Large quantities of ferrochrome were imported from France and the Scandinavian countries before the war, but these sources have been entirely cut off. Practically no chromium is being exported. The metal has advanced about 50 per cent but there seems to be a sufficient quantity available to supply the demands, although prices are higher than ever before.

TUNGSTEN

This metal, which is very largely used in the manufacture of high speed tool steel, is extremely scarce and prices have advanced violently, present market quotations being about $6 to $8 per pound, against about 75 cents per pound before the war. These remarkable advances have been due in very large measure to the acute shortage of tungsten ores.

India produces about 2500 tons of tungsten ore yearly and Australia about 2000 tons, while the world's production is estimated at 10,000 tons. It is obvious, therefore, that about 4500 tons has been cut off on account of the British embargo and since the present consumption of tungsten metal is probably abnormal it has become necessary to attempt to supply the present great demands with about 25 per cent of the world's production of concentrates curtailed as above noted. Portugal produces ordinarily about 1500 tons of ore, but practically none is coming out on account of British financial control. The United States produces less than 2000 tons of tungsten ore, but on account of the high prices prevailing, new sources of supply have been opened up in the Far West.

Practically no tungsten is being exported or imported at this moment, although England, France, and Germany were large exporters before the war. High speed tool steel contains 15 to 20 per cent tungsten. Large quantities of tungsten are also consumed in magnet steel, the demand for which has been unusual, principally on account of the heavy consumption by automobile manufacturers.

FERROTITANIUM

The use of this alloy has increased greatly, due principally to the demands made on steel melters to

(*Continued on Page 78*)

*Metallurgical engineer, Goldschmidt Thermit Company, New York.

Iron and Steel Works Problems of 1915

They Were Chiefly Commercial and the Technical Advance Was Unimportant—The Scarcity of Alloys—Steel Works Progress

BY J. E. JOHNSON, JR.

THE future student of the history of iron and steel will find that conditions in 1915 differed in many respects from those of any preceding year and probably of any succeeding year for a long time to come. Under normal conditions the relations between technical advances and commercial progress are almost balanced. The natural sequence is, of course, that technical advances come first and industrial progress follows in the path so made; but the steps are so short that the sequence is by no means clear without careful examination.

In 1915 all this was changed. The technical advances made were in general those compelled by the cataclysmic changes in commercial conditions, so that while the industrial changes of the year are in some important respects greater than those of any year for a long time past, the technical advances have been of relatively slight importance.

War Brings Depression and Boom

It is impossible to discuss the technical history of the past year without reference to the great war which has profoundly affected the whole iron and steel business in two fundamentally important ways.

First, during the first half of 1915 the business depression resulting from the stoppage of trade by the war left the iron and steel industry in a condition of prostration as bad as in the leanest years of the middle eighteen-nineties, if not worse; then in the second half the commercial conditions were completely reversed, also as a consequence of the war, and the steel trade experienced an over-stimulation not exceeded, if equaled, by the palmiest days of 1907.

Second, the effect of the great war upon shipping has been to cut off or seriously curtail the supply of many of the auxiliary materials of iron and steel manufacture, which are of small tonnage compared with that of steel but are of almost vital importance in its production. Among these the most prominent are ferromanganese and manganese ore, ferrochrome, ferrotungsten, ferrosilicon, magnesite and silica bricks.

No important supply of these materials has been developed in the United States. Nature, which has been so bountiful to this country in most respects, has denied us an adequate supply of some and of others no mines have ever been developed. As a result either the finished products or the raw materials from which they are made have been imported from abroad, and the conditions brought about by the world war have curtailed the supply in two related but separate ways: First, the nations at war have been unable to produce the materials as in times of peace, or producing them have been unable to ship them on account of the naval blockade maintained by one of the belligerents; second, the effect of the great war on shipping has been to raise ocean freights four, six, eight or more times what they were under peace conditions. Ocean freight in time of peace is a considerable item in the delivered cost of materials, so that it is obvious that a many fold increase would raise prices of imports to an extent all but prohibitive.

Scarcity of Auxiliary Materials Used in Steel-Making

There are no important producing mines of manganese ore in the United States, though the famous Crimora mine in Virginia is being re-opened on a scale which it is hoped will enable it to become a considerable producer again. Manganese deposits have been located in various western States and there has been a small production of ferromanganese by the electric furnace in California. But the country's requirements of the alloy are about 250,000 tons in normal years. The closing of the Black Sea cut off the Russian supply of ore entirely and England controlling the Indian supply has placed very stringent regulations around its disposal. The supply from Brazil has been of course greatly handicapped by the effect of the rise in ocean freights on a long voyage such as this. As a result of these conditions there has been constant uncertainty in regard to ferromanganese since the early months of the year. As a result spiegel, as well as ferro of lower content than 80 per cent manganese, has been bought with avidity and at prices far above those prevailing in recent years when such materials have been almost unsalable on account of the decline in the production of Bessemer steel and the increasing use of the open hearth, in which the preferred practice is to add the deoxidizers in the ladle.

The raw materials for the production of ferrosilicon are of course of universal abundance, but the 50 per cent grade which is generally used in steel manufacture can only be produced in the electric furnace and owing to the great development of cheap electric power in Europe nearly all of this material was imported previous to 1911 and about half of our total consumption in recent years. The available electric furnace capacity in this country is entirely insufficient for the production of our full requirements. The revolution in conditions abroad has had the effect of curtailing the supply of this alloy also and, with England even bidding for ferrosilicon from Niagara Falls, there has been a tremendous stringency throughout the year. This has been increased by the attempts made to utilize ferrosilicon for deoxidizing as a substitute for ferromanganese. It has been found that about 25 per cent of the deoxiding can be done with ferrosilicon but that the other 75 must be done with ferromanganese. This indicates that manganese is a very much more powerful deoxidizer than silicon, a result contrary to chemical and thermal theories, but which has nevertheless been found to be the case in other fields than those of steel manufacture.

Ferrochrome has been relatively limited in supply as ferromanganese and ferrosilicon, but this is not a matter of such vital importance to the steel business as a whole, since ferrochrome is only used in a small percentage of the total steel produced, whereas manganese is used in all and silicon in most.

Tungsten is probably the most important of the group of metals used in the production of high speed steels. It has been imported almost exclusively, but when the European supply was cut off acute attention was turned upon the known deposits of tungsten in this country, particularly those in Boulder County, Col., and a very considerable quantity of this ore has been produced from mines in that district. This has sold at enormously high figures and the price of tung-

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sten bearing lands in that district has advanced past recognition. Tungsten has soared in such a way as to make a serious inroad on the profits of the machine shops, and expedients in welding high speed steel cutting points on to shanks of common steel which were "impossible" a year or two ago are current practice in live machine shops to-day.

MAGNESITE AND SILICA BRICKS

The world's principal supply of magnesite has come in the past from Styria, Austria, and this of course has been entirely cut off by the war. Other supplies were known but have never received commercial development in the past for the singular reason, in some of the best known cases, that they were too pure. It seems that the Styrian magnesite contains enough iron and other impurities to frit together when burned at a high temperature, whereas the purer varieties will not do so and great difficulty has been found in introducing the impurities in such a way as to make them answer the desired purpose. This is a problem upon which the brick manufacturers have worked overtime in the past year, and it is understood that the most acute phase of the shortage of magnesite bricks is past.

Certain varieties of silica bricks have been imported from abroad because the exact composition of silica rock to make them has been rather scarce in this country; but this is a line of manufacture in which American manufacturers have been making rapid progress in recent years and the situation has not been so acute as in regard to magnesite.

ZINC

This is an auxiliary material of much importance in a large portion of the iron and steel business. The principal consumption in recent years has been for galvanizing purposes, that for brass probably being second. For common yellow brass ordinary zinc known to the trade as prime western or its equivalent is good enough. But in the past year when orders for cartridges were placed in this country by the billion and for fixed munition for field guns by the million, many people learned perhaps for the first time that the zinc required to make brass that would stand drawing operations must be of special quality, in that its content of lead must be below 0.1 per cent, and that of cadmium about the same. When the enormous orders for cartridges began to arrive the demand for the high grade spelter, from which alone the brass to make the shells could be produced, rose by leaps and bounds, and "cartridge spelter" went from about 7c. per pound last year to 40c. per pound in the summer of 1915, prime western in sympathy going to 27c. or 28c. One result of this situation is that the largest steel producer has built a zinc smelting works of its own at Donora, near Pittsburgh, and is evidently determined never again to be at the mercy of so capricious a market. A plant costing about $3,000,000 has been erected in considerably less than six months and is now in partial operation, with working to full capacity only a few weeks in the future.

Coke

In the production of coke 1915 has probably seen the greatest revolution of any in the history of the American iron trade. The by-product oven had won its fight as regards quality of coke produced and as regards the return on the investment under American conditions a year ago, so that its growth was already at a more rapid rate, but the enormous demand for explosives brought about by the war has greatly accelerated this rate. Benzol is the raw material for the production of phenol and this in turn for the production of picric acid. All three materials were little more than names even to the well-informed a year or two ago. The principal supply of benzol comes from the distillation of coal, and it is recovered from the gases of the by-product coke oven by scrubbing with tar. Benzol has sold at 10c. or 15c. a gallon for years past. It is a satisfactory substitute for gasoline, but no effort had been made to push it for that purpose. Benzol is also one of the basic materials for the manufacture of aniline dyes, but as these materials had been made only by one or two brave spirits in this country who were not afraid to pioneer, the consumption for this purpose a year and a half ago was negligible. With the breaking out of the great war all this was changed. The supply of dyestuffs from Germany was cut off almost absolutely by the English embargo, while the consumption of picric acid probably became greater for each day than it had been for a month or a year previous. In consequence, the price for benzol went up by leaps and bounds, scarcely stopping until it reached 60c., four to six times the price on a peace basis. Similar conditions prevailed in regard to toluol, a relative of benzol, also recovered from coke oven gases but in much smaller quantities. This material when nitrated in a manner similar to that used for glycerine and cotton in the production of nitroglycerine and gun cotton, becomes trinitro-toluol, familiarly known as t.n.t. This material, which sold around 40c. a gallon before the war, has been as high as $4 during the past year. As there are 2 to 2½ gal. of benzol produced per ton of coal coked in good by-product practice, and about ¼ to ½ a gallon of toluol, the value of the materials which could be recovered by the installation of a benzol plant at a coke oven plant of even moderate size became enormous. Such plants have been installed at a great number of the existing by-product coke oven plants which were previously without them, while the profits which could be made in this way have been the deciding factor in starting the construction of several new by-product coke plants. As a net result, the by-product oven has come into its own during the past year at a more rapid rate probably than in any three or four preceding years, and the time when the beehive oven will be as extinct as the dodo has been moved many years nearer.

As a related branch of this subject it may be mentioned that the production of aniline dyes in this country has received much attention and some important commercial developments have already been made along that line. This will have a direct influence in the future upon the value of coke oven by-products, and while this is no place for the discussion of politics, it may not be amiss to express the hope that the Government may see its way so to foster and guard these industries that they may not be destroyed by "predatory competition" from abroad at the close of the war.

Iron Ore

The history of the year in regard to iron ore has naturally been parallel to that of the steel business as a whole. During the first half of the year the demand was very light and production small; in the last half and particularly during the concluding part of the shipping season in the Lake Superior region, it has been a question not of how much ore the producers could sell but how much they could deliver, or how little the consumers could get along with during the closed season.

The past year has brought considerable shipments from Tofo, Chile, through the Panama Canal to the Bethlehem Steel Company, which has bought and developed very extensive iron mines at that point.

The year brought an increased interest in the magnetites, particularly those in the East and in the possibility of concentrating those lean ores not suitable in their natural condition for furnace use. There is no doubt that the near future will see very much more done upon the treatment of ores before they are

charged into the furnace than has been done in the past. The rich ores of Lake Superior have largely spoiled the iron masters of this country. They have become so accustomed to taking out of the ground with the steam shovel ores suitable for charging directly into the furnace that any other method of operation has not appealed to them, but this condition will not last always. One strong group of American interests has bought a large quantity of land at Moose Mountain in northern Ontario containing well above 100,000,000 tons of iron ore in the form of a magnetite of extremely fine structure, almost microscopic, disseminated in a silicious matrix. Several hundred thousand dollars has been spent in experimental work. The material is ground very fine in Hardinge mills and separated on the Gröndal wet magnetic separator and the pulp is then largely dewatered by Dorr classifiers. The Gröndal process was first applied in its entirety, but the small briquets which are used in that process require an amount of handling which is prohibitive from the point of view of American labor costs, and the company has set about the development of methods whereby much larger briquets could be made and the necessity of handling largely if not wholly eliminated. It has been found that briquets formed by pouring the concentrates in the form of a thick pulp into a mold and there solidifying them are many times stronger than the briquets produced by enormous pressure. This presumably is because the water lubricates the particles, and enables them to lock themselves together in the closest and strongest way, whereas when the briquets are formed dry the particles bridge rather than interlock. Experiments are still proceeding to determine in detail the best methods of carrying out this operation. When they are concluded commercial development upon a large scale will be undertaken.

The Blast Furnace

Turning now to the actual production of iron and steel, we find that technical developments in 1915 have been relatively slight. During the first half of the year iron and steel works were running on a scale far below that which enabled them to maintain economical production and thus there was minimum profit if not actual loss. They had, therefore, no funds to devote to technical investigations and experimental developments. In the latter part of the year, on the other hand, the works have been overstimulated to an enormous extent and the entire technical staff has been so overwhelmed with the necessity of keeping production as near as possible 110 per cent of capacity that the skilled men necessary for such investigations have not been available.

STOVES

Much interest continues to be shown in the design and operation of hot blast stoves. Recent years had shown the possibilities brought about by the introduction of clean gas, notably that of reducing the size of the checkers and the thickness of the bricks so as to obtain a greater ratio of surface to volume and a greater number of square feet of heating surface per stove. This year that development has gone still further and corrugated checker bricks have been used to increase this ratio still further.

Much attention has been given to the question of heat loss from the stove and from the bustle pipe and a material quite new in industrial application in this country, but long known in scientific circles as kieselguhr or infusorial earth, has been introduced quite extensively for insulating purposes both under the name of the natural product given by the principal producers, sil-o-cel, and a manufactured product using this material as a base known as cork brick. Both these materials have a thermal resistance something like ten times that of fire brick. These have been used for the exterior lining of stoves and also of hot blast mains and bustle pipes. There is no reason to doubt that they will be decidedly beneficial, though data are not yet available.

Forced circulation of the gas in the stoves has also been tried at one plant and by increasing the velocity through the checkers it has obtained the heat required from three or even two stoves instead of four. This is somewhat along the line of the German development described last year under the name of the P. S. S. system. It is probable that this system is destined to have a considerable growth.

BOILERS

No new types of boilers have been brought out, but very great interest has been shown in better combustion of furnace gas for boiler purposes. At least one new type of burner has been brought out for this purpose, that invented by Mr. Bradshaw, formerly of the Cambria Steel Company, with which practicably theoretical combustion conditions can be maintained under ordinary works management over long periods of time. It can scarcely be doubted that the efficiency of blast furnace boilers will be materially raised by the wide interest taken in this and kindred subjects.

BLOWING ENGINES

No decided lead has been taken by any one of the three principal kinds of blowing engines—the reciprocating steam engine, the turbo blower and the gas engine. One steel plant in the East has installed gas blowing engines during the year, while the largest furnace plant built during the year has installed steam blowing engines, but will use high pressure and very highly super-heated steam. The engines will be run non-condensing and the exhaust will be used by a low pressure turbine generating electricity for the steel works. The economy of such a unit is almost equal to that of the gas engine while its cost of installation is lower.

SLAG HANDLING

A development which has reached industrial importance during the last year is that of the Croxton system of handling slag, first used at the Cleveland Furnace Company, of which its inventor, D. T. Croxton, is president. This system consists in making a bed of fine-broken slag a few inches thick with a series of parallel chains spaced 2 or 3 ft. apart buried under it, the ends of the chains being left exposed and provided with rings. On the bed so constructed the molten slag is run directly from the furnace until a thickness of 2 to 4 ft. is reached. The bed is surmounted by an overhead traveling crane provided with a lifting hook and also equipped with a grab bucket. The crane takes the projecting ends of the chains one at a time and pulls them through the bed of slag thus ripping it into small pieces. These pieces are then removed by the grab bucket and loaded into cars or delivered to a slag screening system, if that should be desired. The slag produced in this way is excellent for concrete purposes, while a good storage capacity is provided without the necessity of any locomotive, crane or the like in attendance during the night, as is required with the hot pot or the granulation systems.

Methods of Steel Production

Ten or fifteen years ago it seemed as though methods of converting pig iron into steel in the United States had reached two permanent standard forms: first, Bessemerizing of low phosphorus stock in an acid lined converter; second, purifying non-Bessemer iron in the basic open hearth furnace with a limey slag containing iron oxides, partly derived from the melting

of steel scrap and partly from ore added to the bath. It is true that there was and still is a small production of steel from low phosphorus stock in the acid lined open-hearth furnace, but this has played only a secondary role from a tonnage point of view for many years past.

DUPLEXING

In the last five years, but particularly in the last two, all this has been changed. The apparent permanence has disappeared and new methods of steel production are rapidly replacing the older ones by the introduction of duplexing. It is, of coursse, well known that the Bessemer converter furnishes a quick and inexpensive method of removing silicon and carbon; but when acid lined it does not remove any phosphorus at all and even if basic lined can be used for the removal of phosphorus only with heavy loss and low output. The open-hearth furnace, on the other hand, while it easily removes the silicon, is a very poor decarbonizer, since the removal of the carbon is very tedious, requiring heavy additions of ore unless very heavy percentages of scrap are used. The open-hearth furnace, however, has altogether the advantage, not only in being able to dephosphorize to almost any desired degree but also in "killing" the steel after it has reached the composition desired. Moreover, the heat can be controlled and can even be held for an appreciable period without deterioration, neither of which conditions exists with the Bessemer converter. The combination of these two methods of steel production by first blowing out the silicon and most of the carbon in the converter and then transferring to the open-hearth for dephosphorizing, greatly increases the rapidity of working in the latter, and thereby increases the output. This correspondingly reduces the capital charges which are high with that type of plant on account of the large investment required per ton of steel produced in the straight open hearth.

Certain other conditions arise, however, which the stationary open hearth cannot meet to the best advantage. Notably, the reduced period required for a heat does not allow time for carrying on the work necessary on the stationary furnace, while the necessity of emptying the furnace completely involves the charging of the blown metal with its highly erosive action directly on the unprotected bottom of the furnace, so that furnace maintenance is difficult and expensive. For these and other reasons the tilting furnace has been very generally adopted for duplexing.

ELECTRIC FURNACE

The last year has seen a decided development of the electric furnace for two other purposes: first, the production of steel castings of ordinary analysis, but more solid and free of blowholes than can be produced by the baby Bessemer or the open hearth; second, alloy steels ranging in quality from the high-priced materials used in automobiles, aeroplanes and the like, up to tool steel itself, of which increasing amounts year by year are being produced in the electric furnace. The control under this process is so complete and oxidizing gases can be so aboslutely excluded from the bath, that material even better than crucible steel has been produced from the electric furnace. It would seem that as far as the crucible process is concerned the handwriting on the wall is plainly visible.

The casting of ingots continues to receive much attention in order that segregation and piping may be reduced and a larger proportion of the ingot rolled into good merchantable steel. The Gathman process is in use at several plants. This consists in making the top of the molds thin so as to reduce the chilling action on the upper portion of the ingot and keep it hot to feed the pipe. The Kenney process accomplishes the same result by lining the top of the ingot mold with a dry sand sleeve set in a recess around the top of the mold. This makes an unbroken outline on the outside of the mold and not only thins down the metal but provides insulation between the steel and the mold.

It is very generally recognized that much better ingots can be made by casting "big end up" but the difficulties of stripping ingots so cast have so far deterred industrial efforts along that line.

STEEL ROLLING

No novelties in the line of rolling mill practice have been brought out in the last year. Much interest continues to be taken in the question of power economy in rolling mill practice, but electric drive for reversing mills does not appear to have made very rapid progress. One development of interest concerning which no operating details are at hand is that at Reading, Pa., a rolling mill (either three high or continuous) is being driven by a 1600-hp. steam turbine directly geared to it. This seems a very desirable arrangement for such mills, and detailed results will be awaited with much interest. One development due to the unusual commercial conditions of the last year has been a deficiency of rolling capacity for rounds 3¼ in. and larger for which there has been such an enormous demand for shrapnel and high explosive shells. These rounds can in general only be rolled on the large mills designed for rolling rails and as the cooling and inspection tables of these mills were not designed for the character of inspection required for this material the rolling capacity of the mills has been limited largely by the capacity of the inspection beds.

The mills making a specialty of the odd sections required for the automobile trade continue to develop their methods so that sections which would have been "impossible" a few years ago are rolled as matters of every-day practice to-day.

Cast Iron

One of the interesting developments of the year has been the introduction into commercial practice of the Stoughton process for melting iron in cupolas in which by far the greater proportion of the coke is replaced with oil. One plant has been in operation for several months, and has been entirely successful from the start; others have been and are being started up. The aim of the inventor was primarily to obtain more efficient melting and reduce fuel cost, especially in those localities where oil is cheap and coke very dear, as on the Pacific Coast, but a secondary result has proved to be probably even more important than the fuel saving. This is that the increase in sulphur on remelting is only a small fraction of what it is in ordinary cupola practice, in that the increase in sulphur varies all the way from 0.03 or 0.04 under very best conditions to 0.01 or more according to the skill of the foundryman and the quality of the coke he uses. A test of several weeks' duration on a Stoughton cupola running with only ordinary supervision has shown an increase in sulphur of 0.008 or only about one-fifth of that to be expected in good practice with coke.

The material known as "Johnson iron," which is coke iron converted into a substitute for and improvement upon charcoal iron by introducing oxygen into it, has experienced a very considerable commercial development, having been used to the extent of many hundreds of tons in the roll foundries where it has given results equal to the best of the high-priced Eastern and Southern charcoal irons. Further developments in regard to this material are shortly to be expected since the process employed in its production enables castings to be produced directly from the blast furnace without remelting, the castings being of superior quality both on account of the introduction of the oxygen and on account of the absence of the sulphur due to remelting.

What May the Iron and Steel Trades Ex

Views of Manufacturers on the Duration of our Pros Needed to Prevent Large Shipments to This Country

American iron and steel manufacturers recognize that the end of the great war may be many months away, but all are thinking intently on questions it has thrust upon leaders of industry in this country. All are shaping their policies in line with the answers they would give to these questions, or in line with the uncertainties growing out of the impossibility of answering most of them. Diametrically opposite views are taken of the effect upon our steel industry of conditions that are considered likely to follow the making of peace in Europe. With a view to eliciting the opinions of men prominent in the iron and steel trades, THE IRON AGE addressed to a number of them a letter suggesting as the basis of a discussion in its columns these questions:

> Will our prosperity outlast the war?
>
> How will immigration and labor conditions at home and in Europe be affected by the war's ending?
>
> What is the future of our export trade in iron and steel?
>
> What legislation at Washington, if any, is called for in view of the changes that are coming?
>
> What are the signs for 1916 in iron and steel? Will the large additions to steel-making capacity that are coming on in every direction leave us with more than we shall need?

It was fully appreciated that some of these questions are clouded in uncertainty and that predictions concerning the first three in particular must vary widely. At the same time it was recognized that whatever steps are taken in this country, in view of the readjustments the end of the war will bring, must be suggested in part by the best counsel available from industrial and financial sources. The iron and steel industries have much at stake in these readjustments, and as will appear from the replies reproduced below, leaders in these industries have some definite proposals which may well have earnest heed from those charged with the shaping of legislative policies on the important economic issues involved.

LEGISLATION THAT CAN PROLONG PROSPERITY

JOSEPH G. BUTLER, JR., YOUNGSTOWN, OHIO

The close of the war in Europe may result in a temporary recession of business in the United States, but that such a recession should have any degree of permanency seems to me to be improbable. Domestic business, which was at a low ebb when the war began, has recovered to such an extent through the stimulus given to many lines by war orders that the depression of 1914 has been overcome in most finished lines. The continued export demand for agricultural products has revived and continued the prosperity of our farmers and furnished a foundation for a permanent market. I believe that with proper and judicious legislation, our present prosperity will continue for many years to come. Probably at the close of the war we may have a brief jar, but I do not think it will last long. The wants of the Government and the railroads will keep our mills and furnaces busy.

Undoubtedly many laborers of foreign birth will return to Europe immediately after the war closes. This condition I think will prevail in the Youngstown district at least, and presumably in many other industrial centers. But these people will not remain in Europe, in my opinion; they will go back mainly to gather up their relatives who were not sacrificed and bring them to this country. The terrible lessons of the war will not be lost on the people of the countries involved and they should more than ever, and no doubt will, appreciate the blessings of living in a country where there are no war burdens and where billions of wealth must be replaced before even normal conditions can be restored.

The future of our export trade in iron and steel will depend largely upon the efforts made by the United States to gain a footing in foreign countries. First and foremost, we must have an American mercantile marine. Every possible effort should be bent in this direction. European manufacturers will be unable for some years to present such formidable competition as in the past; on the other hand, they will eagerly seek markets where money is to be found and such markets will be scarce in Europe. Therefore, we will have to contend with their efforts to regain their lost trade in South America and other countries and possibly even keener competition in these countries than has been heretofore felt. This competition is to be feared more in the matter of price than in quantity or quality of products and we should be able to overcome it on that account.

Imperative need exists for a broader view in national legislation, and existing laws should be so amended as to present less discouragement to large business enterprises. Especially burdensome to business has been the legislation against what is known as interlocking directorates, by which men of recognized ability and experience have been robbed of the most valuable opportunities to acquire information of value to their corporations and also that co-operation which is so essential in the conduct of large business enterprises. We need to have the tariff placed on a scientific basis by the creation of a non-partisan tariff commission. I have been an advocate of this plan for more than twenty years. I was instrumental in some small degree in pressing to a conclusion the formation of the first tariff commission of which the late Henry W. Oliver was a member. But when this tariff commission was created the time was not ripe; it was intensely a political matter at that time and I think is becoming less so as we progress. Above everything we need a more generous interpretation of the motives and purposes of men at the head of industrial operations by our national legislators.

pect When Peace Is Declared in Europe?

perity—Legislation Safeguarding Against Dumping Is —Tariff Revision and Tariff Commission Advocated

The fifth question, "What are the signs for 1916 in iron and steel?" involves the consideration of our export business touched upon in my reference to the need of a merchant marine. Undoubtedly and unquestionably the extensions now under way in the different plants building and projected will increase the productive capacity of these industries beyond a normal increase in domestic consumption. It has been the history of this country that we overbuild but finally grow up to the capacity. This fact has already been discounted by such industrial leaders as James A. Farrell, president of the United States Steel Corporation who sees the solution for his own company and for the independent interests alike in the creation of an export market.

The third annual convention of the National Foreign Trade Council takes place in New Orleans Jan. 27, 28 and 29. Mr. Farrell is at the head of this organization, and many leading financiers and manufacturers are among its members. I believe this convention will result in great good and I have hopes for large results in deliberations.

Finally, if we can create a healthy export demand and at the same time protect our home markets from European competition, the coming year should be one of the best in the history of this country.

TARIFF COMMISSION NEEDED, ALSO A CHECK ON IMPORTS

WILLIAM E. COREY

In your letter of Dec. 15 you present two opposite views of possible trade conditions following the end of the European war, as follows:

1. "That this country will be drawn upon to such an extent in the physical reconstruction of Europe that with the home demand there will be little or no letdown from the present scale of operations, which is in so important a way the result of war orders and of European steel-makers' inability to export to their customers of years."

2. "That European industry, particularly in Germany, being released from the tremendous demands of war and spurred by the necessities of millions of men returned to the ranks of producers, will push its products into foreign markets and will make such prices as will sell these products, regardless of costs or prevailing market prices in other countries."

These questions as presented by you are the subject of earnest consideration by all thoughtful men. Much can be said in support of either view, and it is manifestly impossible to arrive at any certain conclusion. However, after giving due weight to the arguments on both sides, I am of the opinion that we may reasonably expect prosperous trade conditions in this country for a considerable length of time succeeding the end of the war.

As to your question regarding needed legislation: speaking generally, I am not a high tariff man, but extraordinary conditions demand special treatment and in the words of a distinguished statesman, "It is a condition and not a theory which confronts us." It would seem to be only ordinary prudence to prepare as far as possible for either of these contingencies, and the only sure way to accomplish this is to frame our tariff laws so as to afford some protection to our trade from sudden upheavals due to the necessities of our foreign competitors. This could be accomplished either by an amendment to the Underwood tariff act, or by giving the President authority, under certain conditions, to impose some check on importations, either by increase of duty or by temporary embargo.

Finally, regardless of any other action, we should have a permanent tariff commission. The present method of procedure in framing our tariff schedules in Congress may be likened to the methods of establishing freight rates which were formerly in vogue, whereby the shipper who was able to wield influence, political or financial, was enabled to profit at the expense of his competitors. A tariff commission, composed of men having wide business experience, would become as important and valuable a factor in our foreign trade relations as the Interstate Commerce Commission has become in domestic trade, and whatever may be the shortcomings of the latter no one would dream of returning to the chaotic conditions which obtained prior to its creation.

EUROPE'S COMPETITIVE POSITION NOT GREATLY WEAKENED

JOHN A. TOPPING, CHAIRMAN REPUBLIC IRON & STEEL COMPANY

Your letter unquestionably brings to the front questions of vital interest to the trade and opinions in reply should be full of interest. Present trade conditions are conceded to be without parallel in history and consequently history as a "lamp of experience" does not light the way. Prosperity, however, in my opinion, should outlast the war, even though war was the stimulating factor which lifted business out of its inertia; *for war not only meant increased demands for our products, but it meant protection of a prohibitory character,* for it shut off all hurtful competition on competitive products and produced a prosperity that stimulated imports of non-competitive products. Therefore, if we prepare for peace as we should, i.e., fortify business against unfair attack from without by new legislation, protected as we are from within from unfair competition, without accumulated wealth and present banking facilities, enterprise and prosperity should be extended.

On the other hand, with our home markets without protection, with wage standards now the highest ever known, and transportation advantages in the hands

of our foreign competition, without legislative defenses our prosperity will unquestionably be adversely affected. While we may assume that labor abroad will suffer heavy losses, yet these losses undoubtedly will be offset by labor saving devices and reduced employment due to impoverishment and retrenchment, and therefore Europe's competitive position is not likely to be seriously weakened by increased costs.

We also must assume that our export trade will suffer heavy shrinkage, because munition purchases will end with the war; and aside from such purchases it is reasonable to suppose that Europe *will discourage imports on all products of a competitive character* to minimize gold exports and unemployment. It is quite possible, however, that part of our loss in European trade may be offset by trade gains in other parts of the world, but such gains, in my opinion, would be only a small part of our war order losses.

The legislation I would suggest for peace preparedness is tariff revision upward, and such modifications of our merchant marine laws as will encourage rather than discourage ocean shipping.

The outlook for 1916 is most encouraging, as peace is not in sight and present commitments will carry production to full capacity for months to come, and also absorb all new capacity which can be brought in. If peace should be established during the year, the increasing demands for constructive purposes should carry us, at all events, through the year. Should we fail to provide against an invasion of our home markets by foreign producers, inasmuch as European industry, is now operating at approximately 75 per cent of capacity, we may anticipate quick mobilization of forces for an export effort; therefore, much depends upon Government co-operation if we are to realize a prolonged period of prosperity.

WHAT PEACE WILL BRING—PROSPECTS FOR 1916

L. C. HANNA OF M. A. HANNA & CO., CLEVELAND

The questions you ask, at least several of them, are not easily answered. As regards prosperity outlasting the war, there is in my opinion but little doubt that it will. The demand for steel for war uses, together with the regular export trade, I should say will remain substantially on its present basis until peace is reached. Our home market is at the present time in several lines considerably below its normal basis, and should and I believe will increase. How long this condition will continue, I confess I am unable to judge, but I certainly feel, until peace comes. It will take considerable time after peace is declared for the industrial world abroad to adjust itself to the changed conditions, but my feeling is that its effect on the trade of this country will be immediate and that for a period we shall be unfavorably affected.

As to the future of our export trade in iron and steel, I feel that much depends on the policy of the present and the next administrations. Under our present tariff schedule there can be but little headway made, and should the President's recommendations for revenue be adopted our chances for progress will be still further reduced. There is no doubt that our tariff must be restored, if success is to follow the industry. For the first half of 1916 success seems now to have been established in practically all branches of the iron and steel industry, but beyond July but few seem inclined as yet to commit themselves. Many consumers have bought raw material throughout the year and over to the spring of 1917, while others are inclined only to commit themselves for six and nine months.

PRODUCTIVE CAPACITY MAY PROVE TO BE EXCESSIVE

ISAAC M. SCOTT, PRESIDENT WHEELING STEEL & IRON COMPANY

1. We believe that the present prosperous conditions in the steel trade will outlive the European war, provided the war does not continue more than a couple of years longer.

2. With the ending of the war we expect to see immigration increase, thus improving a condition that will likely become rather serious during the coming twelve months.

3. We should be able to retain at least a good part of our present export trade, particularly that with South America and Mexico. With the improved conditions in the latter country, our export business should very materially increase in that direction during 1916.

4. The Underwood tariff bill should be amended, first, by increasing present duties by at least 10 per cent; second, by writing into this rather crude measure an anti-dumping clause.

5. Nineteen-sixteen will doubtless be a good year in the steel trade, but the high prices that are prevailing will swell productive capacity to a point that will be somewhat troublesome when the boom is over. Based upon experience a reaction will follow this era of prosperity, and until such time as the country's consumption grows up to a point that will care for this increased capacity, interrupted operations and lowering prices will obtain.

THE POSSIBILITY OF SERIOUS MARKET INVASION FROM EUROPE

SEVERN P. KER, PRESIDENT SHARON STEEL HOOP COMPANY, SHARON, PA.

I am of the opinion that at the end of the present European war we are going to find the nations of Europe so tremendously involved financially that it will be imperative for them to put all men to work who are capable of working, whether they would have been considered able bodied before the war or not, and in addition the women of continental Europe will be found in increasing numbers performing manual labor to whatever degree is necessary for the rebuilding of their nations. These influences combined cannot help producing at least as large a volume of manufactured products as was produced by Germany before the war but with a highly stimulated production I think even a greater quantity of manufactured material will be produced. Going out into the world's markets to bring back money from the neutral countries to meet the

(*Continued on Page* 91)

INDUSTRIAL PROGRESS of SIXTY YEARS

The Lifetime of THE IRON AGE

THE IRON AGE completed in the summer of 1915 the sixtieth year of its existence. In these sixty years greater advances have been made in science and industry than in all the years in the history of mankind that preceded them. A simple recital of development in the years between 1855 and 1915 makes a record so impressive that it is almost unbelievable, and yet every event in that record is within the memory of men still living. Prior to 1855, if we exclude the discovery of America, there were but four discoveries or inventions which left a distinct impression on civilization, and altered in a marked degree the course of human events. In the arts of peace, these were the invention of printing, the invention of the steam engine and the development of the factory system. In the art of war, the discovery of gunpowder worked a revolution in methods of conflict and made the foot soldier the superior of the mailed knight on horseback. And although the art of war has made stupendous advances since 1855 the new methods, with the possible exception of the submarine, have been largely adapted from the arts of peace.

In 1855 the electric telegraph was but ten years old and had only begun to take its place in the economic life of the world. The steel rail which was to enable the railroads to penetrate and open vast areas of the country was still in the future. Sails and the wind were still the principal motive power for war vessels, and they were still not a little relied on by merchant ships. The steam engine, though vastly improved since the time of Watt, was still a crude machine compared with the almost perfect mechanism into which it was developed before the steam turbine began to displace it at the beginning of the present century. Sixty pounds per square inch was a high pressure for steam boilers in 1855, and superheating was unknown. To-day pressures of 200 lb. per square inch are not uncommon, and large power plants are seldom designed without provision being made for superheating.

In the iron and steel industry the year 1855 marked the beginning of an epoch. Prior to that time blast furnaces were built of stone, and a furnace which produced twenty-five tons of iron a day was considered large. Coke was almost unknown as a metallurgical fuel. Steel was made only in crucibles, in the blister furnace, the puddling furnace and the Catalan forge. The hammer and the squeezer were the principal means of working iron into shape for the rolling mill. The three-high rolling mill was yet to be built. Chemistry was as yet unheard of as an adjunct to iron and steel metallurgy.

But in 1855 the revolution in the industry began. In that year the first patents were issued for the Bessemer process. John Fritz, at the Cambria works in Johnstown, Pa., rolled the first 30-ft. rail, and began to visualize the first three-high mill, which he built two years later. In April, 1855, the ship canal at Sault Ste. Marie was opened, making available the vast deposits of the rich Lake Superior iron ores, and on Aug. 17 of that year the first iron ore cargo, amounting to 132 tons, passed through the canal, the forerunner of a traffic that is now measured in scores of millions of tons every year. In 1855, also, were these Lake Superior ores first successfully used in the blast furnace in Pennsylvania, foreshadowing the wonderful development of the Pittsburgh district and the rapid rise of Pennsylvania to the position of foremost iron producing State in the country. In 1856 Frederick Siemens patented his gas producer, which later made the open-hearth steel process practicable.

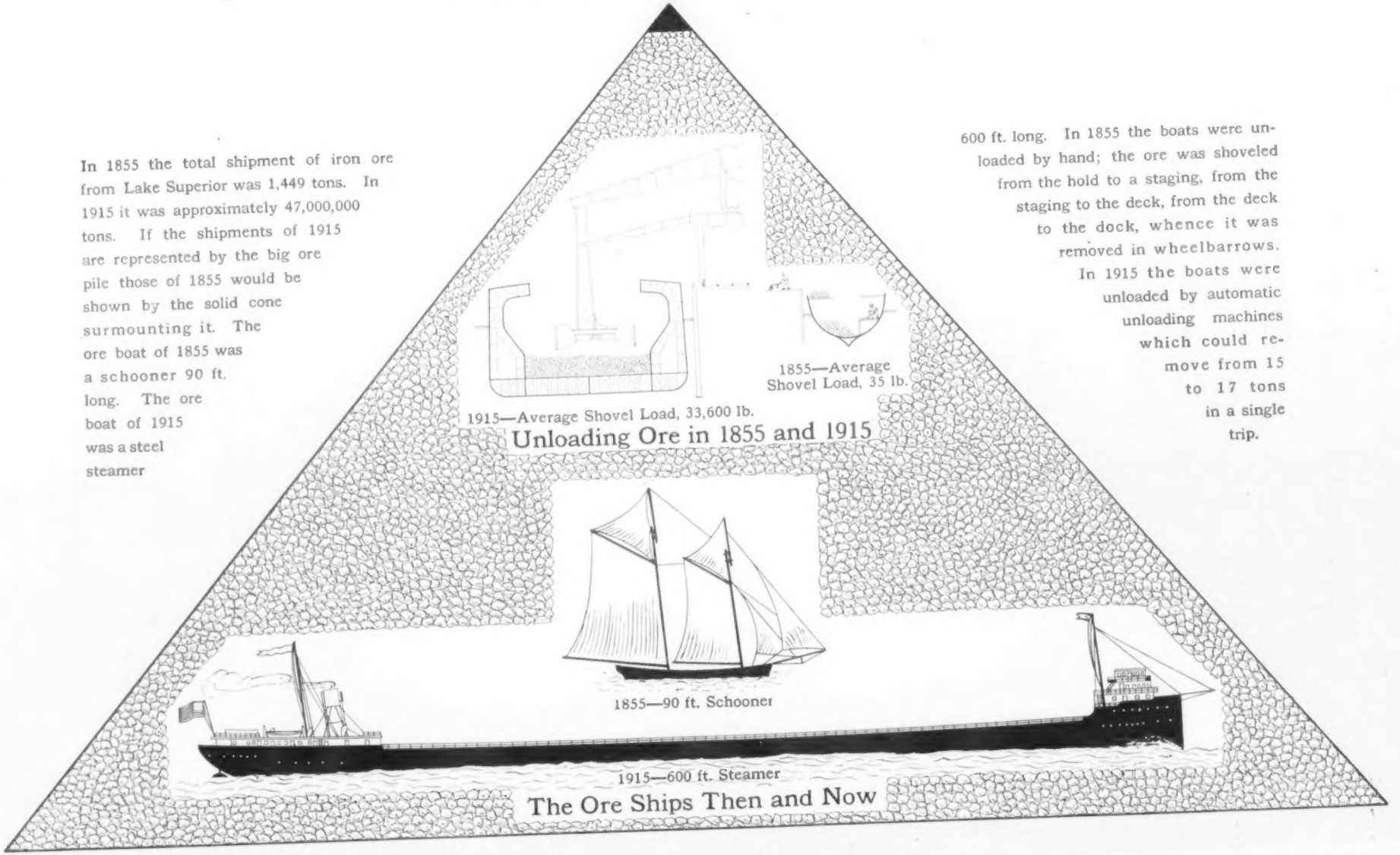
To record all the industrial and scientific developments that have taken place in the last sixty years would require more space than is available for this rapid résumé. It is here possible to touch on only the more important of the achievements. Since 1855 there has come into being the science of electrical engineering, around which centers a great part of the commercial and social life of the present day. In this science are included: the telephone; the electric light; the transmission of power to vast distances, which has made possible the utilization of large water powers such as Niagara; the electric motor, which has revolutionized many industrial processes, and which has enabled urban and interurban transportation to be developed to a point hitherto undreamed of, and extended transportation facilities to country districts where the steam railroad could never penetrate; wireless telegraphy, which in ten short years has saved countless lives at sea, but which has, on the other hand, helped to make warfare more murderous; the X-ray, which has proved a wonderful tool in the hands of the surgeon; the electro-chemical industry, which has had a far-reaching effect on civilization—these are but a few of the important branches of electricity which have been developed since 1855.

It is worthy of note that while all of this marvelous development has taken place within sixty years, the greater part of the advance has been made in the later years of that period. Indeed, the basic inventions, with but few exceptions, were first made public a number of years after the beginning of the era under consideration. The direct-current electric dynamo was invented by Gramme in 1870, and the electric motor was developed from it in 1873. The telephone first appeared in 1876. It was some years before it was more than a scientific wonder, and not until 1915 was it possible to telephone across the American continent. Electric lighting first made its appearance in 1876 in the shape of the Jablochov candle, and shortly afterward Edison perfected the incandescent lamp, which has been constantly improved until to-day it has a brilliance and power far exceeding the best illuminants of 1855. The first public electric power station was established in 1881, in New York. The electric car first became a commercial success in 1888, at Richmond, Va., and this initial installation was crude and imperfect in construction; it was in the nineties that electric traction began to assume the proportions which it has now attained. The electric transformer, proposed in 1883, was perfected a few years later and made possible the transmission of power to long distances; but it was 1891 before the first polyphase long-distance transmission system was exhibited. Eleven years later, with the construction of the power plants at Niagara Falls, the first use of these inventions was made for the development of water powers. Wireless telegraphy became possible with the completion of Marconi's experiments in 1896, and the first transmission of messages across the Atlantic by this method took place in 1902. The X-ray was discovered in 1895. The principle of the storage battery was discovered in 1861, but twenty years elapsed before it was made a commercial possibility.

Thus in but a portion of its life THE IRON AGE has witnessed the beginning and the growth of a science that has literally transformed the face of the earth. Marvelous as are the developments in electricity, they are matched by the inventions made in the mechanical and chemical industries. These, while they may not be as spectacular as the triumphs of electricity, have none the less contributed quite as much

Iron Ore in 1855 and 1915

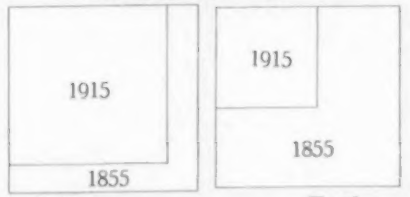
In 1855 the total shipment of iron ore from Lake Superior was 1,449 tons. In 1915 it was approximately 47,000,000 tons. If the shipments of 1915 are represented by the big ore pile those of 1855 would be shown by the solid cone surmounting it. The ore boat of 1855 was a schooner 90 ft. long. The ore boat of 1915 was a steel steamer


1915—Average Shovel Load, 33,600 lb.
1855—Average Shovel Load, 35 lb.
Unloading Ore in 1855 and 1915
1855—90 ft. Schooner
1915—600 ft. Steamer
The Ore Ships Then and Now

600 ft. long. In 1855 the boats were unloaded by hand; the ore was shoveled from the hold to a staging, from the staging to the deck, from the deck to the dock, whence it was removed in wheelbarrows. In 1915 the boats were unloaded by automatic unloading machines which could remove from 15 to 17 tons in a single trip.

The Advance in the Method of Producing Iron and Steel from 1855 to 1915

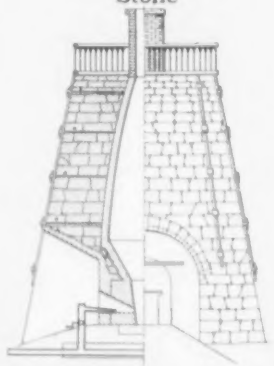
Raw Material Required for One Ton of Pig Iron in 1855 and 1915

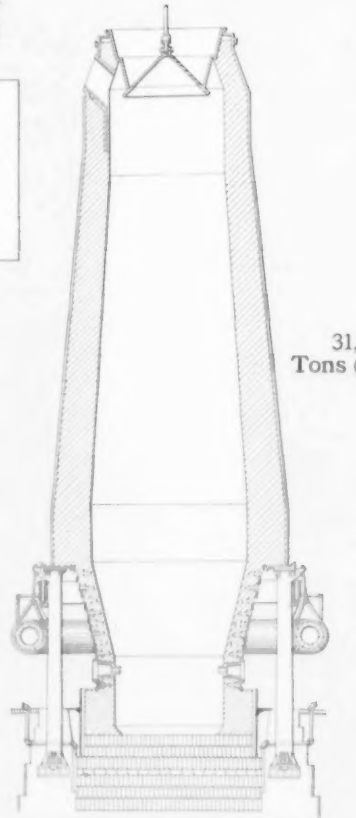


Ore

Fuel

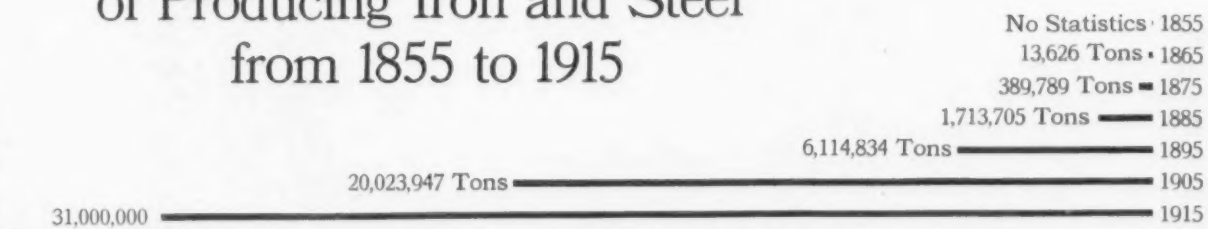
Stone



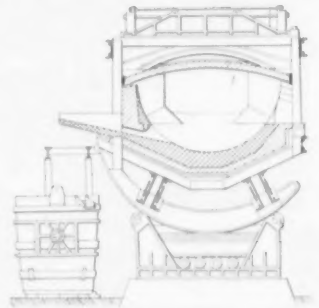


Progress in the Blast Furnace Industry in 60 Years

Steel Production During 60 Years



Steel Manufacture in 1855 and 1915


1915—A 100-Ton Open Hearth

1855—Blister Steel Furnace

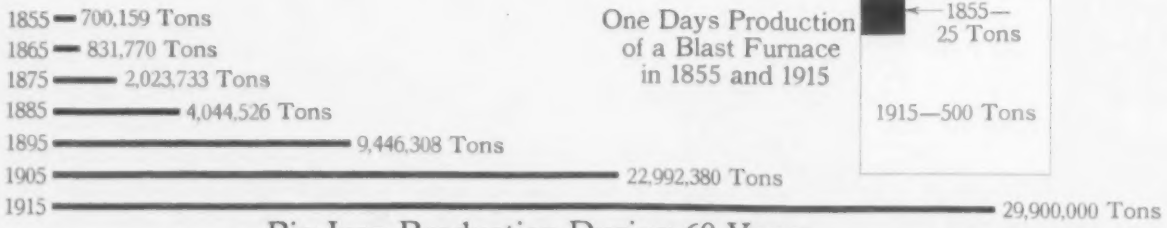
1855—Crucible Furnace

The Rolling Mills of 1855 and 1915

1915—A 40-In. Blooming Mill

1855—An 18-In. Roughing Mill

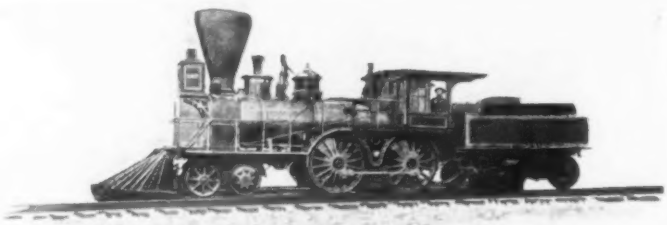
Pig Iron Production During 60 Years



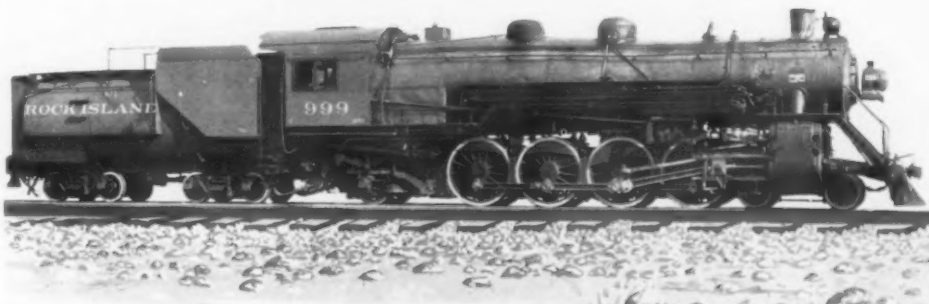
One Days Production of a Blast Furnace in 1855 and 1915

1855—One Months Production of a Blister Steel Furnace—30 Tons
1915—One Months Production of a 100-Ton Open Hearth (Duplexing)—25,000 Tons
1855—One Months Production of a Crucible Furnace—6 Tons

The Growth of Transportation Facilities in America in 60 years.

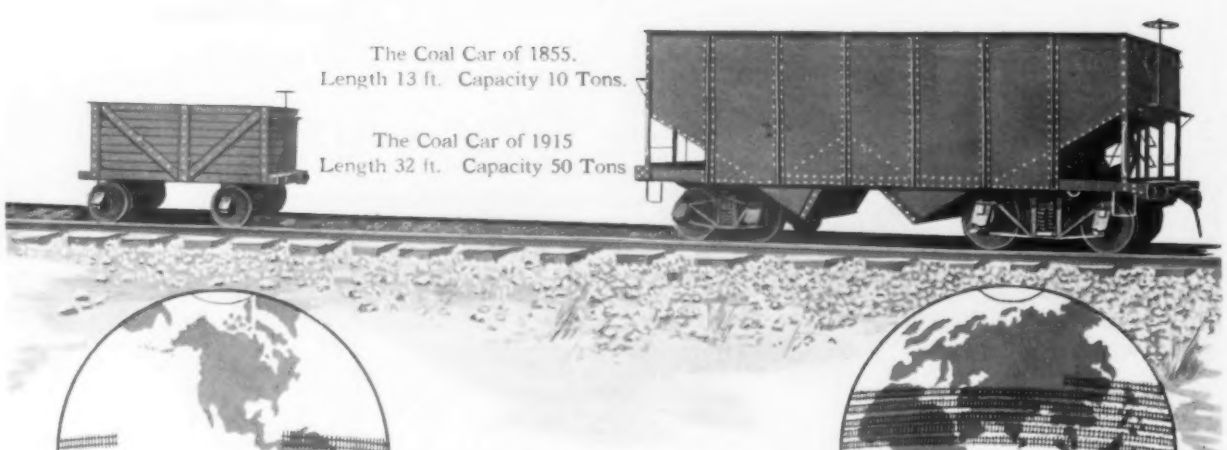


The Locomotive of 1855. Wheel Base 18 ft. Weight 56,000 lb.



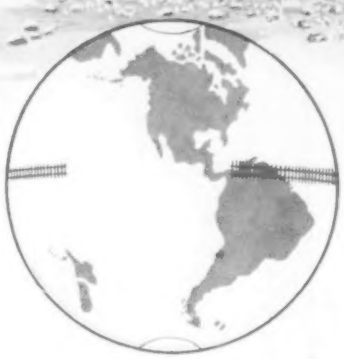
The Fast Passenger Engine of today. Wheel Base 38 ft. 11 in. Weight 333,000 lb.

The Largest Locomotive in the World in 1915. Wheel Base 90 ft. Weight 853,000 lb.

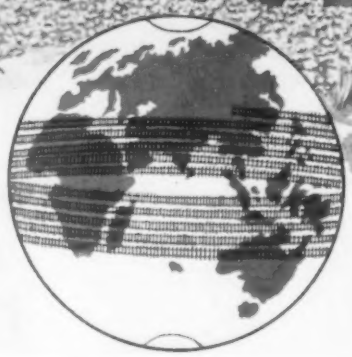


The Coal Car of 1855. Length 13 ft. Capacity 10 Tons.

The Coal Car of 1915 Length 32 ft. Capacity 50 Tons



In 1855 the 18,374 miles of Railroad in the United States would go $\frac{3}{4}$ of the way around the earth at the equator.



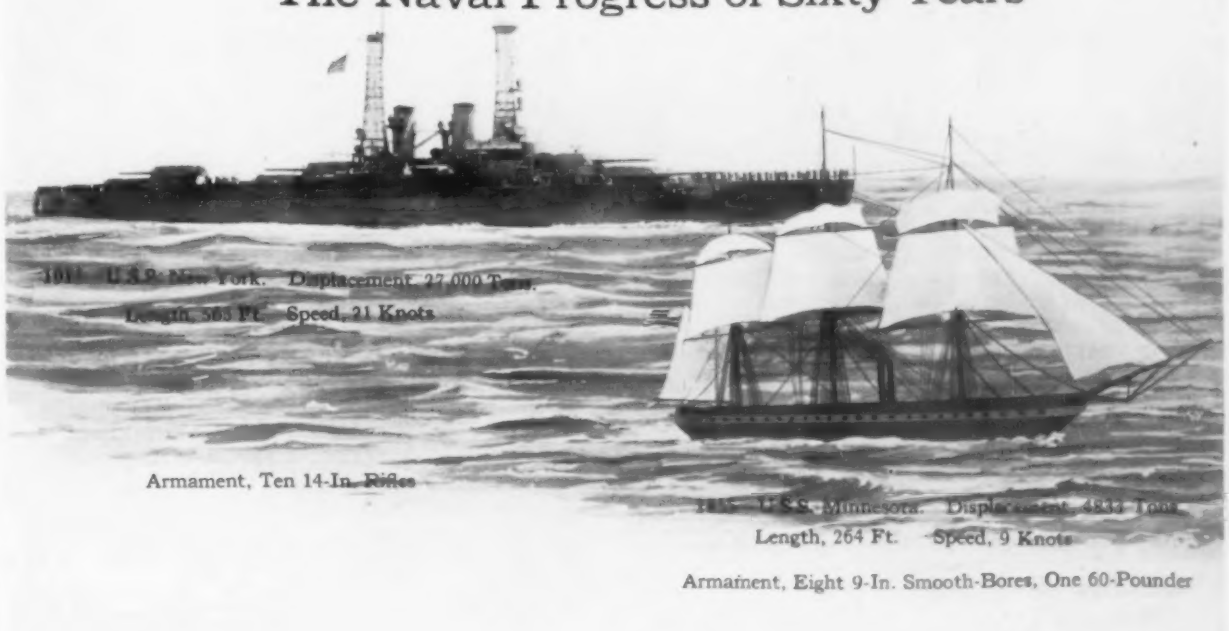
In 1915 the 258,500 miles of Railroad in the United States would go $10\frac{1}{5}$ times around the earth at the equator.

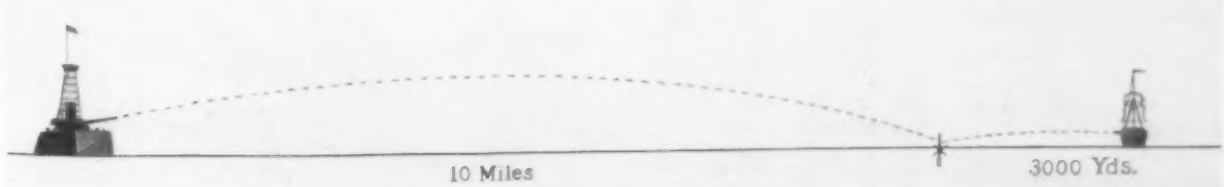
Sixty Years in Steam Navigation

1915—The Aquitania. Length, 901 Ft.
Tonnage, 47,000. Speed, 21½ Knots
1855—The Persia. Length, 336 Ft.
Tonnage, 3300. Speed, 13.8 Knots
New York
Aquitania 576 Miles
Persia 345 Miles

One Day's Sail of the Ship of 1915 and of 1855

The Naval Progress of Sixty Years


1911—U.S.S. New York. Displacement, 27,000 Tons.
Length, 565 Ft. Speed, 21 Knots
Armament, Ten 14-In. Rifles
1855—U.S.S. Minnesota. Displacement, 4833 Tons.
Length, 264 Ft. Speed, 9 Knots
Armament, Eight 9-In. Smooth-Bores, One 60-Pounder



The Battle Ranges of 1855 and 1915

to the advance in the comfort and welfare of mankind, and have left their mark on civilization. On the accompanying pages the attempt is made to portray pictorially the growth in the more important industries utilizing iron and steel, by contrasting the practice of 1915 with that of 1855. In the representations of present-day practice, in only one or two instances have the largest mechanisms of the period been chosen. It has been the aim rather to show what may be called the normal development than to illustrate freaks.

THE MANUFACTURE OF IRON AND STEEL

In 1855 the blast furnace in common use in this country was a stone structure, about 30 ft. square at the base and of the same height. At the base on each of the four sides arches were formed through which the tuyeres were led to the furnace and the iron and slag tapped. The furnace was heavily banded with iron, and was surmounted with a chimney. Although the hot blast had come into use at this time, the cast iron pipe stove was the only means available for heating it. The regenerative firebrick stove did not appear until 1860. The interior shaft of the furnace had much the same form that it has to-day, except that the boshes were flatter and all the dimensions necessarily much smaller. The fuel in most common use at that time was charcoal, and while coke was known and even used to a small extent it was not highly thought of. An elaborate textbook on the manufacture of iron, published about 1855, contains the following interesting statement: "There are four furnaces in Pennsylvania using coke, but the modern charcoal furnace has attained such perfection that it is unlikely that the number of coke furnaces will be increased." In 1855 the following quantities of raw materials were required to make one ton of pig iron: Limestone, 3957 lb.; fuel, 5448 lb.; ore, 5732 lb. In 1915 the blast furnace had grown in size until it ranged in height from 90 to 100 ft. and improvements in practice had increased its capacity to 500 tons of pig iron per day. Some furnaces have been built which are larger than this, but the 500-ton furnace now seems to be regarded as a standard. While the blast furnace has grown in size, improvements in practice have lessened the quantity of raw material needed for a ton of iron to the following: Limestone, 752 lb.; coke, 1702 lb.; ore, 4003 lb. The great improvement in the blast furnace has not come so much from notable inventions as from a better understanding of the principles of its working, the increased rate of driving consequent upon the use of higher blast pressures, and the application of chemistry to iron manufacture. The firebrick stove and the Gayley dry blast are the commanding inventions in blast furnace practice in the sixty years just closed.

Turning now to the steel industry, we find that in 1855 it was practically non-existent. The Bessemer process was invented in that year, but did not come into general use for several years later. The open-hearth process was not successfully developed until 1864. The crucible furnace, the puddling furnace from which came the now obsolete wrought steel, and the blister furnace were the only steel-making mediums of any account in 1855, and the capacity of these, measured by the standards of to-day, seems almost a jest. In the crucible furnace 50 lb. of steel could be made in three hours, while of blister steel a production of 10 or 12 tons in twelve days was about the limit of capacity of a large furnace. In 1915, open-hearth furnaces were in operation which had a capacity of 100 tons of steel at a single heat, and using these in connection with the Bessemer converter in the duplex process a heat can be run off every three hours. The 10-ton Bessemer converter making three blows an hour has approximately the same steel-making capacity.

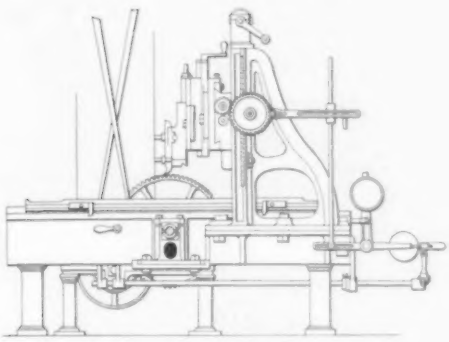
The far-reaching effect of the invention of the Bessemer and open-hearth processes was not confined to the iron and steel industry. The almost immediate result of the adoption of the Bessemer converter in the United States was a great impetus to railroad building, with a resulting rapid development of the vast areas of the Central West. This was accomplished through the medium of the steel rail. The old iron rails were not an especially durable product and the cost of manufacture was considerable. The Bessemer process put in the hands of the iron and steel industry a method of producing a durable rail at a price which enabled the railroads to extend their lines into what would otherwise be unprofitable territory. The effects of the Bessemer process, therefore, extended far beyond the immediate environments of the iron and steel industry, for the extension of the railroads was indirectly responsible for the development of areas and industries which otherwise would at best have had slow growth.

Steel making, in the period under consideration, unlike the iron industry, has several notable inventions to mark its progress. Two of these, the Bessemer converter and the open hearth, we have already considered. Another step in advance was the invention of the Jones mixer. This, while not having far-reaching effects outside of the industry, like the steel rail, contributed to the development of the continuous process in the manufacture of steel. At the beginning of the sixty-year period the metal from the blast furnace was cast into pigs and afterward re-melted before being made into steel. The practice of to-day requires that the liquid metal pass from the blast furnace to the steel making furnaces in the liquid state and from the furnaces to the finishing mills without becoming cold.

A development in the latter part of the period was the duplex process in which a portion of the work of steel making is completed in the Bessemer converter while the remaining work is done in the open hearth. The immediate effect of this was to decrease by about one-half the amount of time required for making steel by the open-hearth process. The electric furnace is another great development in the steel industry and this is a matter almost of yesterday. During the past year it has been utilized in conjunction with the duplex process for the final refining of steel, thus giving what may well be called the triplex process of steel making. Another notable step in iron manufacture during this period was the gradual substitution of coke for charcoal in the blast furnace. Shortly prior to 1855 anthracite had been adopted in a few furnaces instead of charcoal and in the years immediately following it came into quite extensive use. The development of the coke industry, however, soon operated to displace anthracite by coke and this displacement has progressed until now there are but a few furnaces left which use anthracite as fuel. The by-product coke oven also is a product of the years between 1855 and 1915.

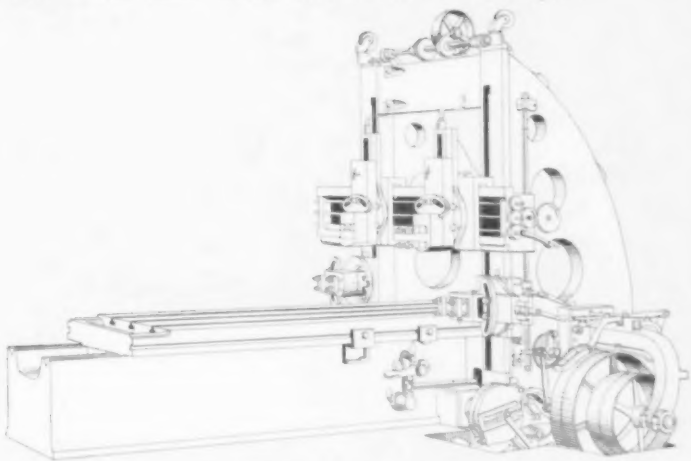
The most impressive thing about the iron and steel industry, however, is not inventions, nor processes, but the growth of the industry itself. Starting with a production of pig iron in 1855 of but a little over 700,000 tons, which in ten years had increased to only about 832,000 tons, the production thereafter doubled or more than doubled during each decade up to 1905, in which year the total output of pig iron in the United States was close to 23,000,000 tons annually. In the past ten years the rate of production has increased at a slower rate, the 1915 output being estimated at close to 29,900,000 tons. The increase in the use of steel has been still more notable. In 1855 the production was too small to warrant the collection of statistics regarding it. In 1865 the total production of steel of all kinds was but 13,626 tons and this was ten years after Bessemer had first patented his converter. Ten years later the total output of steel was less than 390,000 tons, but after that date the manufacture of steel increased at a rate relatively far more rapid than that of pig iron. In 1885 it exceeded 1,713,000 tons; in 1895 it was over 20,000,000 tons per year. The estimated production in 1915 is 31,000,000 tons.

Sixty Years Progress in Machine Tools

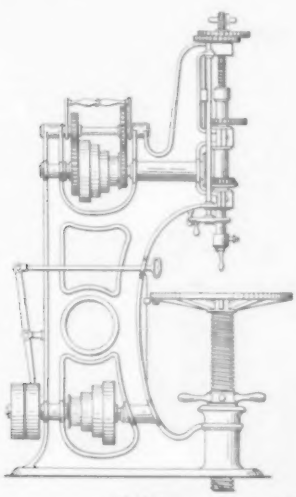


1855

Planers

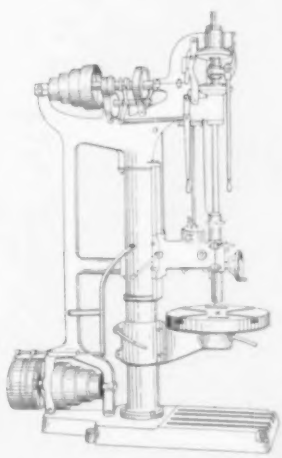


1915

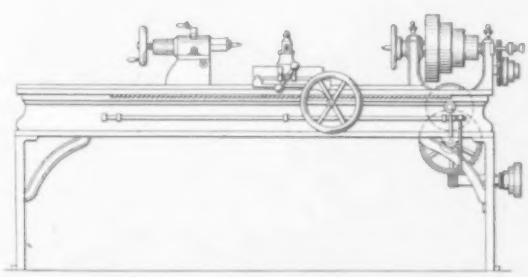


1855

Drill Presses

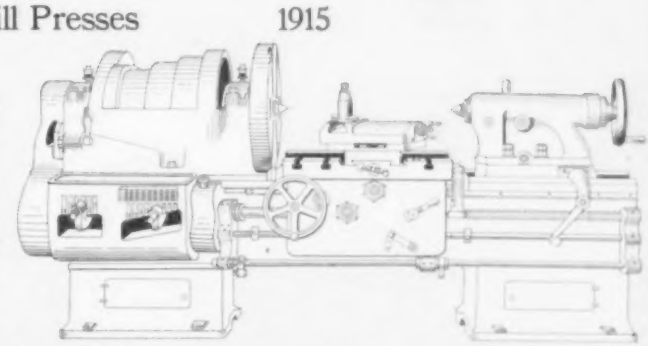


1915



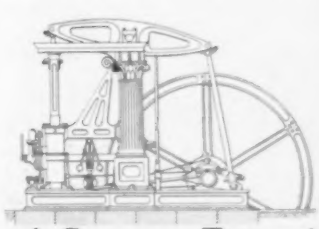
1855

Engine Lathes

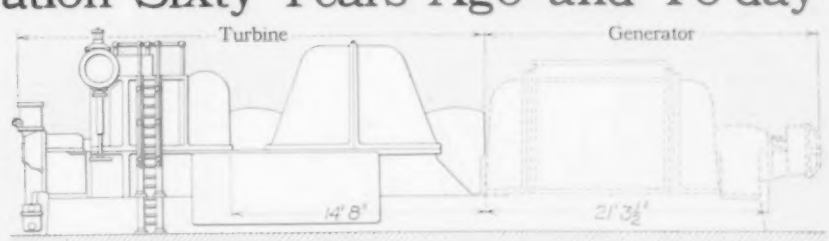


1915

Power Generation Sixty Years Ago and To-day



A Common Type of Steam Engine in 1855 Capacity 20 Horsepower



The 35,000-Kilowatt Steam Turbine of the Philadelphia Electric Company, 1915

Keeping pace with the growth of output of finished products the output of raw materials entering into them has likewise grown with startling rapidity. The ore shipped through the Soo Canal has grown from 1449 tons in 1855 to 47,000,000 tons in 1915. In 1855 the typical ore carrier was a schooner about 90 ft. long. In 1915 the accepted type of ore boat was a steel steamer 600 ft. long, although larger ore ships have been built and are in operation on the Great Lakes. In 1855 the ore boats were unloaded by means of the primitive hand shovel and wheelbarrow. In 1915 ore unloaders which could take from 15 to 17 tons at a single grab were used. By means of these a cargo of 10,000 tons of ore can be unloaded within a few hours.

PROGRESS IN MECHANICAL ENGINEERING

In mechanical engineering the most spectacular development between 1855 and 1915 has been in the field of power generation. In the late 40's Corliss had perfected his valve gear which marked a new era in steam engine construction and which became the dominant type for steam engines during the remaining years of the nineteenth century. Notwithstanding the fact that the Corliss engine was available in 1855, the beam engine was still an extremely popular type of machine. It was rapidly displaced, however, by the Corliss and other forms of automatic engines which were improved as years passed on until no further improvement seemed possible. The steam engine was at the very zenith of its career when, almost in a day, it was displaced for large powers, at least, by the steam turbine. This mechanism first began to attract serious attention in the eighteen-nineties and during the first ten years of the present century it made rapid progress. Not only has it the advantage of being far more economical than the steam engine, but also the immense advantage of concentrating enormous power into small space. The contrast between power generation of to-day and of 1855 is well illustrated in one of the accompanying comparisons wherein are shown a 20-hp. beam engine of 1855 alongside of the 35,000-kw. steam turbine of the Philadelphia Electric Company. These are both drawn to the same scale, from which it will be observed that the turbine concentrates in a smaller area than the steam engine over 1000 times the energy.

One other development in mechanical engineering has been fully as revolutionary as the steam turbine. Although really in the domain of metallurgy, nevertheless it resulted from an extended experiment in mechanical engineering and was the work of an engineer and not a metallurgist. We refer to high speed steel. In 1855 the machine tools of the country had in general attained the form which they were destined to hold for nearly fifty years. Modifications there were in design, it is true, but in general the machines of 1900 varied but little in principle and strength from those of a half century previous. In 1906 Frederick W. Taylor presented to the world the result of his researches on the art of cutting metals. Included in this research was the discovery of high speed steel, and the publication of Taylor's work rendered obsolete every machine tool in the country. No machine then in existence was powerful enough to do the work demanded of it if the new tool steel was to be used to its full capacity. The years immediately following 1906, therefore, witnessed a complete redesign of all machine tools. The effect is readily seen in the accompanying comparisons of the tools of 1855 and to-day.

It is impossible to do more than mention the more important inventions and discoveries of the past sixty years in the domain of mechanical engineering. Those which stand out in the boldest relief are the gas engine and gas producer, the aeroplane, the linotype and monotype, which together with the perfecting press, have worked wonders in the art of printing, the phonograph, the automobile, the car unloader, the traveling crane, the Wellman charging machine. Most of these are in such common use that it seems as if they were always with us, but nevertheless most of them have come to pass within the last thirty years.

TRANSPORTATION

In transportation the principal advance has been in the size of the rolling stock and in the capacity of trains. A typical locomotive in 1855 burned wood as fuel and weighed under 30 tons. A fast passenger locomotive to-day weighing 100 tons is by no means considered an exceptionally large locomotive. The same or even greater strides have been made in freight locomotives and the largest locomotive in the world, a triplex compound of the Mallet type, weighs 426 tons. With the locomotive, the capacity of the cars also has increased. A 10-ton wooden 4-wheel coal car of 1855, 11 ft. long, has become the 50-ton, 35-ft. steel hopper car of 1915. The light 40 and 50 lb. rails of 1855 have been replaced by rails weighing from 85 to 120 lb. to the yard. As the railroads have grown in size so too have they grown in extent. The 18,374 miles of railroad in the United States in 1855 had become in 1915 258,000 miles. In 1855 a trip from Albany to Buffalo consumed 23 hours on the fastest train. To-day the Empire State Express makes the same run in six hours. A man could go from New York to Chicago in 1915 in less time than he could go from Albany to Buffalo in 1855. In 1855 an average train load on the Pennsylvania Railroad was about 61 tons; in 1913 it was 719 tons.

CIVIL ENGINEERING

The sixty years have been marked by wonderful feats in the domain of civil engineering. The Suez and Panama Canals have been built, the Alps have been pierced by numerous railroad tunnels and in the United States there have been completed works which will rival any in this most ancient of sciences. In and around New York City alone projects have been completed which stand among the wonders of the world. The New York subway, opened in 1904, marked an epoch in civil engineering, and it is to be overshadowed by the vast new subway developments now nearing completion in New York. For thirty years attempts were made to tunnel the Hudson River without success, but within ten years no less than six railroad tunnels have been driven underneath it, while under the East River eight railroad tunnels have been completed and others are nearing completion. The Catskill aqueduct, a part of the water supply system of New York, just nearing completion, will stand as one of the greatest engineering works of all times. The steel frame building making possible the construction of tall business blocks and towers also is a product of the last thirty years.

MARINE ENGINEERING

In the domain of marine and naval engineering the progress of sixty years is no less noticeable than it is in the other fields. The steamship Persia put in service in 1855 had a length of 375 ft., a tonnage of 4000 and a speed of 14 knots. The Aquitania of 1915, 901 ft. long, with a tonnage of 47,000 and a speed of about 22 knots, is not the largest of ocean passenger steamers. In 1855 the United States frigate Minnesota was the most powerful warship in the world. She was 265 ft. long and displaced 4800 tons; under steam and sail she had a speed of 9 knots. Her armament comprised eight 9-in. guns and one 60 pounder. The battleship New York, of 1915, displacing 27,000 tons, having a length of 565 ft. and a speed of 21 knots, is not the largest nor the fastest of modern warships. Nor is her armament of ten 14-in. rifles the most powerful in the world. The effective battle range of the Minnesota was about 3000 yards, while the New York could successfully carry on a conflict at a distance of 10 miles. In naval architecture the year 1855 is notable because in that year armor was first used on warships. It was long after 1855 when wood was finally abandoned as a material for building either merchant or naval vessels. During the lifetime of THE IRON AGE, therefore, the entire science of naval engineering has been changed.

Modern Artillery and Future Development

The Principles of Gun Construction, Their Life, Types and Range—Effect of the War on Methods and Mechanism

BY LIEUT. LOGAN CRESAP, U. S. N.

THE science which treats of the motion of projectiles is called *ballistics*, and this science is divided into two parts: *interior ballistics*, which includes a study of all the conditions existing in a gun from the moment the powder charge is ignited until the moment the projectile leaves the gun; and *exterior ballistics*, which treats of the motion of the projectile after leaving the gun. Interior ballistics, thus considers all matters pertaining to the design and action of the gun, carriage and powder, while exterior ballistics deals with the design and action of the projectile.

Interior Ballistics

A cylinder under internal pressure, leaving out of consideration longitudinal stresses, can be ruptured in two ways, either through tangential strain, which may split the cylinder, or through radial strain, both of which strains have their maximum effect on the interior surface of the cylinder. It is easily demonstrable, further, that there is a limit for all metals to the wall thickness beyond which any additional thickness adds but little to the ability of the cylinder to withstand internal pressure. This limit is at a point where the wall thickness is approximately the same as the internal diameter. Such a cylinder of forged steel of 60,000 lb. elastic limit will be ruptured by an internal pressure of but 37,000 lb. per sq. in., and a cylinder of infinite thickness of the same material will be ruptured by an internal pressure of 45,000 lb. per sq. in. Modern artillery demands internal pressures of from 30,000 to 40,000 lb. per sq. in., so it is evident that single piece large guns are out of the question. In small guns, such as rifles, material of higher physical properties can be used, but in large forgings this is at present impossible. It will be noticed also that these limiting pressures are much less than the elastic limit for compression of the material.

A cylinder under external pressure will be ruptured on the interior surface through a tangential stress of compression, which is the greatest stress brought into action. A cylinder of forged steel of 60,000 lb. elastic limit (elastic limit for compression assumed the same), with a wall thickness equal to its internal diameter, will be ruptured by an external pressure of about 26,500 lb. per sq. in., and theoretically a cylinder of unlimited wall thickness of the same material will be ruptured by a pressure of 30,000 lb. per sq. in. Here, again, is shown the insignificant gain in strength secured by increase in wall thickness above the internal diameter.

It is quite apparent and is easily demonstrable that a cylinder will stand a greater internal pressure when under external pressure than when not under external pressure. For instance, a cylinder of a material with 60,000 lb. elastic limit, with a wall thickness equal to the inner diameter, under an external pressure of about 26,500 lb. per sq. in., will stand an internal pressure of about 56,000 lb. per sq. in. before a rupture will take place.

DEVELOPMENT IN CONSTRUCTION

For centuries guns were made of single-piece forgings and castings, and during those centuries there was naturally very little advance in gun construction. But during our Civil War, Captain Rodman, U. S. A., applied this principle of adding external pressure to the metal nearer the bore (and therefore under the greatest stress in action) in cast-iron guns by cooling the gun from the interior by water circulation. In these guns the interior layer of metal around the bore cooled first. As each succeeding increment or layer cooled it contracted, causing a stress of compression on the preceding increment or layer. This method was quite successful, and a 20-in. Rodman gun weighing 117,800 lb. was produced which threw a shell weighing 1048 lb. about 8000 yd.

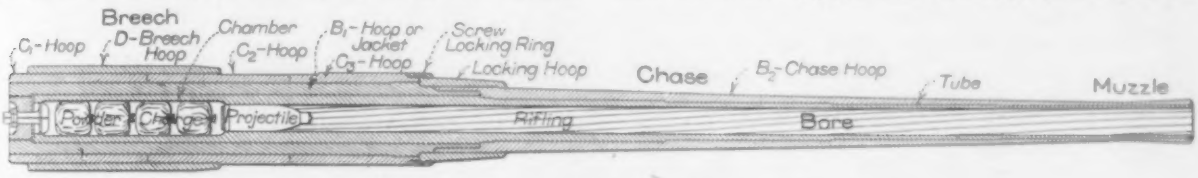


Fig. 1—Naval 12-In. 45 Caliber Gun

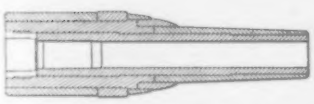


Fig. 2—Coast Defense 12-In. Mortar, About 12 Calibers

	Naval	Mortar
Weight, lbs.	119,000	29,000
Powder charge, lb.	300	50
Projectile weight, lb.	870	1,046
Muzzle velocity, f.s.	2,700	1,150

Fig. 3—Type of Hook Joints

The next development in this principle of gun construction, which is called *initial tensions*, was the famous Parrot gun, in which a wrought-iron band was shrunk on the breech or rear end of a cast-iron gun which was made on Rodman's principle. Since the Civil War progress has been more rapid. European and American ordnance engineers developed this principle of initial tensions, the manufacture of forged steel developed, ordnance engineers and steel manufacturers co-operated, efficient rifling was secured, powder and explosives were improved and within 50 years the present 14-in. guns, weighing about 150,000 lb., firing a projectile weighing 1400 lb., with ranges for accurate fire, of approximately 25,000 yd. or more, has been made possible, and the 16-in. gun with a projectile weighing about a ton and about the same effective range is under way.

PRINCIPLE OF INITIAL TENSIONS

Modern guns are constructed on the principle of initial tensions by shrinking one cylinder over another. Small guns use but two layers, while

larger guns have three and four layers. The shrinkage causes pressure on the exterior of an inner cylinder and an equal pressure on the interior of the next outer cylinder. This pressure on the interior of the outer cylinder of course weakens that cylinder but strengthens the inner cylinder. It is quite apparent, therefore, that the pressure created by the shrinkage should be so regulated that when the system is stressed by an internal gas pressure,

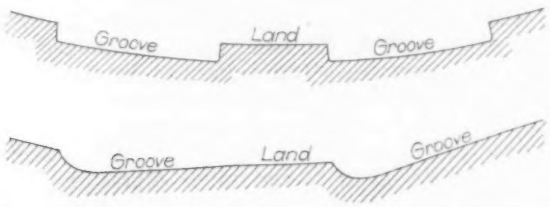


Fig. 4—Two Types of Rifling Showing the Plain Section Groove Above and the Hooked Section Groove Below

the outer cylinder will not reach its elastic limit, before the next inner cylinder has reached its elastic limit.

Now the pressure transmitted through the cylinder walls is proportional, as we have seen previously to the wall thickness. It is possible, therefore, to so adjust the wall thickness of cylinders and the shrinkage between cylinders, that each cylinder will reach its elastic limit with the same internal pressure; or in other words, that all the cylinders will, should the internal gas pressure be sufficient, reach their elastic limit at the same time. With such guns much higher gas pressures are possible than with the old single-piece guns, and this increased possibility was accompanied by corresponding developments in projectiles and powder.

Of course these various cylinders, when assembled to form a gun, are held together longitudinally by considerable friction due to the shrinkage pressure but, in addition to that, they are locked together by various types of hook joints, one of which is shown in Fig. 1, and numerous shoulders. The gun is built up, starting from the tube; each cylinder being added, while heated to roughly 600 to 800 deg. Fahr., the parts already assembled being cold. This process continues step by step until the gun is complete, and then the bore is finished to size, the gun is rifled and the breech machined. In Fig. 2 is shown a naval 12-in. gun with the various cylinders and parts of the gun named. Coast-defense guns are about the same as naval guns. In Fig. 3 is shown a 12-in. mortar, drawn to the same scale as the gun in Fig. 2.

Guns are generally described briefly by giving their bore diameter, called caliber, and their total length in terms of calibers. Thus, a 12-in. 45-caliber gun is a 12-in. gun of a total length of 45 ft. Such a brief description gives a fair approximation of a gun's power because, generally speaking, the power of a gun increases as its length increases.

WIRE-WOUND GUNS AND RIFLING

An effort has been made, with some success, to still further increase the strength of guns by substituting for the intermediate forged cylinders of the above described system, a series of wire windings. This is in effect merely an increase in the number of cylinders or layers. Such guns, called wire-wound guns, are stronger than the forged built-up guns. They, as will be easily appreciated, lack girder strength, and this system is more suitable to short guns than to long ones. And further, the added strength leads to the use of higher pressures, which increases the erosion and therefore decreases the life of the gun. In consequence, wire-wounds are being made only for special and limited purposes in this country. Abroad they have been more extensively used. The British navy uses them to quite a large degree while the American navy does not.

Accuracy of fire is, of course, greatly enhanced by *rifling*, and all modern artillery is rifled. Rifling also permits of the use of elongated projectiles, which secures greater explosive carrying capacity. In small arms the projectile itself "takes" the rifling, while in artillery a copper band is put on the projectiles for that purpose. The section of the rifling varies, but there is general adherence to the two types shown in Fig. 4. The amount of rotation which is given depends on many factors and differs quite widely in different guns. A twist of about one turn in twenty-five calibers is the average rule. In some guns the twist of the rifling is *uniform;* while in others it is *increasing*, beginning with a slight twist and gradually increasing in degree until at the muzzle the maximum twist is reached. The latter is general American practice. Small arms and light guns have uniform twist.

Early powders were quite erratic, giving different pressures with the same charge, and hence, to be on the safe side, comparatively small charges had to be used. The perfection of the modern introcellulose and nitro-glycerine powders, however, remedied this condition. It is, of course, highly desirable that the pressure in the gun be maintained to a considerable degree during the passage of the projectile along the bore and, after many experiments, this was accomplished satisfactorily by molding the powder grains into shapes which maintained the burning area as a grain consumed. Such shapes are thin stripes and perforated cylinders.

For small arms simple irregular spherical grains are used, but for artillery the perforated grain has become the standard American practice. In small guns the grain is about 1/32 in. in diameter and has one axial perforation, while in the largest guns the grain is about 7/8 in. in diameter and has seven perforations, as shown in Fig. 5. The length of a large grain is about 2 in., and the small grains are longer, relative to diameter. The *web-thickness* and size of the grain are varied to meet the desired rate of burning. In Fig. 6 is shown some typical pressure curves, the pressure being plotted against travel of projectile.

The breech of all modern guns is closed with either an interrupted screw plug or some kind of

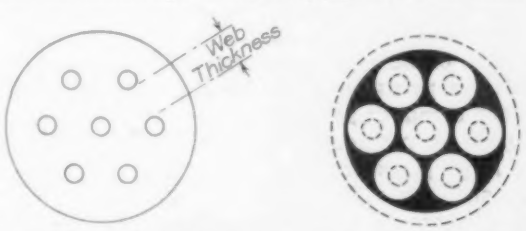


Fig. 5—Powder Grains Showing the Unburned Multi-Perforated (Left) and the Partially Burned Multi-Perforated Grain (Right)

bolt or wedge plug. In Figs. 7 and 8 are shown the general characteristics of a screw plug. In such plugs the breech is sealed by an expanding pad or soft metal ring, and the gun is fired by a primer which shoots a flame through the axial hole in the mushroom or plug. In small arms and small guns the seal is secured by the cartridge case which expands on discharge, and the gun is fired by a primer located in the base of the case.

All guns except small arms and very small guns require a mechanism for the absorption of the recoil, and this mechanism generally takes the form

of a hydraulic cylinder, in which the displacement of the liquid is controlled by varying the size of the escape orifices. Guns are generally returned to the firing position by arrangements of springs or weights.

Exterior Ballistics

A projectile after being launched is acted upon by two forces—gravity and air resistance. As a result the path of the projectile is a curve. Fig. 9 shows this curve approximately and indicates by name the various elements. The velocity of the projectile after discharge depends on its weight and shape. The lighter a projectile is, the greater will be the relative effect of wind resistance and hence the more rapid the slowing down. Also the finer the lines of the projectile, the smaller will be the relative effect of wind resistance, and hence a projectile with fine lines will have a more sustained velocity.

To secure fine lines, however, carrying capacity and penetrating ability must be sacrificed. On the other hand, varying the weight of a projectile for any gun, the muzzle velocity being fixed, causes the weight of the charge to vary in proportion, which of course reacts on the pressure and hence on the strength of the gun. In fixing the design of the shell therefore, all these and other factors must be considered and a compromise struck. The object desired is to carry as much destruction to the enemy as accurately as possible. As a result, the base of most projectiles is left square and the *ogival* is pointed on a radius which varies from two and one-half to six times the diameter.

TYPES OF PROJECTILES

There are three general types of projectiles now in use—shrapnel, common or high explosive shell, and armor-piercing shell. These types are shown in Fig. 10. The shrapnel is used by both armies and navies, but generally where men are the object. The high-explosive shells are used by the armies against intrenchments and fortifications, and by navies against unarmored vessels and some fortifications. Armor-piercing shells are used by sea-coast and naval artillery against armored vessels. In this type of shell cavity capacity has to be somewhat sacrificed in order to obtain penetrative ability. The cap of soft steel on the point is there for the purpose of supporting the point on impact with armor, and its presence increases the penetrative ability of the shell.

VARYING THE BALLISTIC FACTORS

Some concrete examples of the effect of varying the various factors which enter the ballistics of a gun will best serve to bring out the points which have been explained previously.

1. Length of gun: Increasing the length of a 6-in. gun from 40 to 50 calibers with the same powder charge and chamber will increase the muzzle velocity from about 2150 f.s. to about 2300 f.s.

2. Size and shape of powder grains: This is best shown by the curves in Fig. 6, all of which are curves which have been obtained in 6-in. guns with different powders and projectiles and chamber capacities.

3. Air resistance on shell: A 10-in. shell of standard shape traveling at 2800 f.s. encounters a head-on resistance of about 2700 lb., which causes a retardation of about 180 f.s.s., but when its velocity has been reduced to 2000 f.s. the resistance is only about 1500 lbs., which causes a retardation of only 100 f.s.s.

4. Weight of projectiles: Varying the weight of the projectile has two effects; first, that on the chamber pressure and initial velocity, and second, that on the trajectory. For instance, in a 5-in. 50 caliber gun, a certain charge will give a 50-lb. shell a muzzle velocity of 2880 f.s., while the same charge of the same powder will give a 60-lb. shell but 2709 f.s. muzzle velocity. Now a 50-lb. shell of standard design fired at 2880 f.s. muzzle velocity with 3 degree elevation will have a range of about 4650 yd., will fall at an angle of 5° 21′, and will have a striking velocity of about 1205 f.s.; while a 60-lb. shell of the same shape and fired at the same velocity and elevation will have a range of 5030 yards, will fall at an angle of 5° 04′, and will have a striking velocity of about 1309 f.s.

5. Shape of projectile: A standard 5-in. shell fired at a certain elevation and velocity will give a range of 6300 yd., while a 5-in. shell of the same weight with a point sharpened to a radius of six or seven times the diameter, and fired at the same elevation and velocity, will give a range of about 7800 yd.

THE LIFE OF GUNS

There are various ways of explaining the deterioration of guns. One which appears to answer as well as any is as follows:

The temperature of the powder gases upon discharge is quite high. Now, while the time element

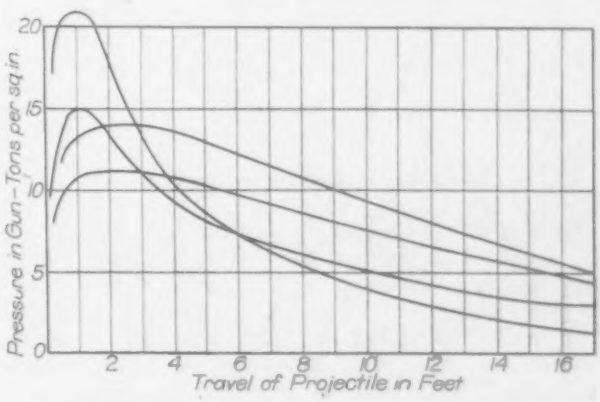


Fig. 6—Typical Pressure Curves with the Pressure Plotted Against the Travel of the Projectile

is small, yet the gun of course absorbs heat. This absorption is confined to a thin film of steel on the interior surface. This local heat expansion causes the film to tend to expand, and there being no room to expand naturally, due to the cooler and thicker wall, the elastic limit is reached and actual compression or set takes place. Upon the release of pressure and in consequence temperature, contraction of the film occurs, and as it has been crushed, this contraction causes minute cracks. This process continues, the minute cracks getting larger on each discharge. As they enlarge they form by-passes for the hot gas, which tends to further enlarge them.

This process continues until the inner surface gets badly roughened and the lands begin to be eaten away. Finally the bore gets so enlarged that gases can escape, the shell does not attain its proper rotation and the flight of the shell becomes erratic and subject to errors. When the gun no longer maintains a reasonable accuracy it is said to be worn out.

The degree of heat is the most important element in this process, and the degree of heat is proportional to the kind of powder and the pressure. Nitro-cellulose powders appear to give lower temperatures than nitro-glycerine powders, and that is one reason why American practice sticks to nitro-cellulose powders. It is also one of the reasons why the percentage of nitro-glycerine in the English cordite was reduced from about 60 to the present 30 per cent.

Efforts are being made of course at all times to

lengthen the life of guns. Vaselines and waxes in powder will decrease the temperature by absorbing heat, but at the same time they increase the weight of the charge with resulting complications. Some powder is graphited, and this appears in some instances to show slight improvement. Lapping the bore to a fine finish also helps somewhat. But such devices are not efficient and do not materially help matters.

RELINING A GUN

All guns except small ones are now constructed with liners in the tube, which, when the bore is worn out, are removed and replaced with new liners.

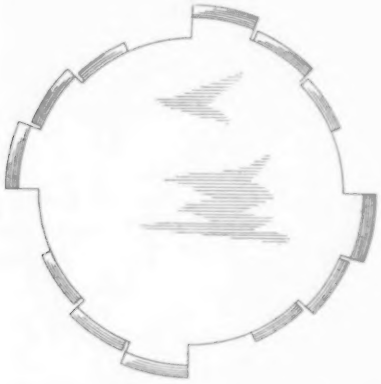


Fig. 7—Interrupted Screw Breech Block

The cost of thus relining a gun can be roughly fixed at about 30 per cent of the cost of the gun. There appears to be no limit to the number of times that a gun can be relined, and hence the life of a gun can really be stated as indeterminate. It is, of course, a matter of arbitrary decision as to when a gun should be relined, as the criterion depends solely on what is considered as the accuracy desirable.

It is difficult to generalize on this subject. The small arms used in this country are considered to be worn out after 5000 to 7500 rounds have been fired. Small naval guns have been fired about 1000 times before they were regarded as worn out. Large 12-in. and 14-in. naval guns are considered to have a life, on one liner, of from 150 to 200 rounds. Low velocity guns, such as howitzers and mortars, have corresponding longer lives than high-velocity guns of the same caliber, because the pressures they use, and hence the temperatures, are lower.

As will be seen from the preceding, the power and life of guns are functions of each other. The amount of power that can be wisely sacrificed for the sake of preserving the gun is not only extremely difficult to decide, but depends on many factors, some of which are subject to national policy. Taken broadly, caliber for caliber, permanent fortification artillery can be given the greatest power, naval artillery can be given almost as great power and field artillery can only be given moderate power. There are, of course, variations from this statement for special purposes.

COMPARING GUNS

Comparison of guns is difficult to make and should only be made after a proper consideration of the life, weight, strength, trajectory, rapidity of fire, accuracy, and projectile of the guns to be compared. Brief and general statements sometimes made in the lay press may be quite misleading.

The following comparison of two guns of different calibers, but of about the same power, shows how difficult it is to draw brief conclusions:

	8-In., 35 Cal. Gun	7-In., 45 Cal. Gun
Weight of shell, lb	260	165
Muzzle velocity, ft. seconds	2,100	2,700
Muzzle energy, ft. tons	7,948	8,338
Theoretical penetration of armor at muzzle, in.	10.7	12.7
Velocity at 6000 yd. range, ft. seconds	1,485	1,810
Energy at 6000 yd. range, ft. tons	3,793	3,745
Theoretical penetration at 6000 yd. range, in.	6.5	7.2
Velocity at 9000 yd. range, ft. seconds	1,272	1,481
Energy at 9000 yd. range, ft. tons	2,914	2,507
Theoretical penetration at 9000 yd. range, in.	5.2	5.4
Velocity at 12,000 yd. range, ft. seconds	1,152	1,247
Energy at 12,000 yd. range, ft. tons	2,930	1,778
Theoretical penetration at 12,000 yd. range, in.	4.5	4.2
Approximate rate of fire per minute	3	6

The 8-in. 35-caliber gun while less powerful at close range is more powerful at long range, and on account of its larger shell, with larger explosive charge, is a more destructive weapon. On the other hand, the 7-in. 45-caliber gun with its higher velocity and flatter trajectory and on account of its greater rapidity of fire is a more valuable weapon for defense against, or attack on, poorly armored craft. In other words, each is supreme for the purpose for which it was designed, and superficial comparisons are valueless.

METHODS OF USING GUNS

In naval warfare the target is in plain sight and on the same level. Naval guns are therefore constructed to fire directly at the target, and the flatter the trajectory the greater is the relative size of the target. This is best shown in Fig. 11. It needs no description to show that a projectile traveling between *a*, *a* has greater chances of hitting than one

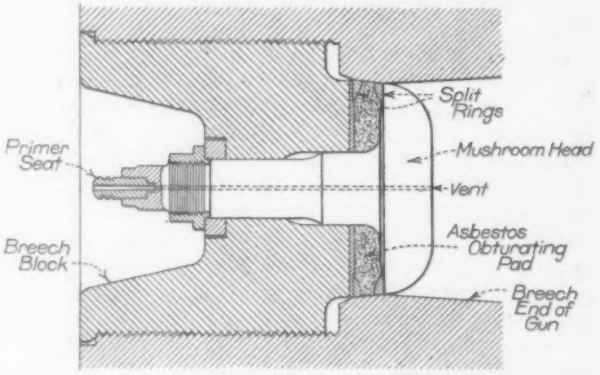


Fig. 8—Details and General Characteristics of a Plug

traveling between *b*, *b*. The distances A and B are called *danger spaces*, and as there are many difficulties in estimating the range accurately it is easily seen that the greater the target's danger space the greater are the chances of hitting. Sea coast artillery is, except as noted below, subject to the same conditions, and in such artillery *direct fire* is always used, and the tendency is to make such guns very powerful and with high velocity.

War vessels are not as well protected against attack from above as from approximately horizontal attack. Sea coast fortifications are, therefore, fitted with short guns called mortars, which are hidden in pits, which send their projectiles high into the air dropping them on vessels. Such fire is called *indirect fire*. In indirect fire the danger space is, obviously, quite small compared to that of direct fire, and due to the great height to which projectiles attain, their lower velocity, effect of the wind, etc., indirect fire is not as accurate as direct fire.

In land warfare these two methods of attack are, of course, both used. Rifle fire and light artillery fire are all direct fire, but generally speaking fire

against fortifications, both permanent and temporary, is by indirect fire. Such fire secures the best protection to the artillery and at the same time makes the protection by the enemy more difficult. Artillery for indirect fire is further, caliber for caliber, much lighter than direct-fire artillery, due to the lower velocities used, and in consequence the transportation problems, both for guns as well as ammunition, are much simpler.

In direct fire the gun with the proper elevation is sighted, at the gun, directly at the target. In indirect fire the gun is given the proper elevation and direction, at the gun, by reference to local fixed or datum points.

KINDS OF GUNS

As we have seen above, naval and coast-defense guns, except mortars, all have the same general characteristics, the most striking of which are high velocity, direct fire and immobility. Land artillery, however, presents highly different characteristics, the difference being caused primarily by the necessity for mobility. In fact, land artillery is called *mobile artillery.*

Mobile artillery is classified according to its degree of mobility. A six-horse team can be easily handled and can pull with a high degree of mobility a load of about 4000 lb. The lighter artillery, therefore, is restricted to that weight, and in this class come the mountain and field guns of from 2.5 in. to 4.0 in. caliber, firing projectiles of from 7.5 to 35 lb. The next class are the heavier siege guns and howitzers, using eight-horse teams, varying in caliber from 3.5 in. to 6.0 in. and firing projectiles of from 40 to 125 lb. Howitzers are short guns which secure their range by high angles of elevation. The distinction can be best shown by direct comparisons. Field and siege guns are fitted to fire at angles of elevation up to about 20 deg.,

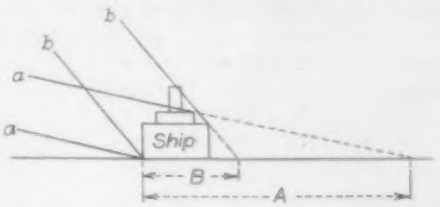


Fig. 11—Relation of Battleship to Target When Firing at Sea

and howitzers at angles from about 20 to 45 deg.

	3.8-In. Field Gun	3.8-In. Howitzer
Weight, lb.	1,534	391
Travel of projectile in gun, in.	94	30
Weight of projectile, lb.	30	30
Muzzle velocity, ft. seconds	900	690
Powder charge, lb.	3	1.2

A 4.7 in. siege rifle or gun will have a muzzle velocity of from 1500 to 2000 f.s., while a 4.7 in. howitzer will have a muzzle velocity of from 800 to 1100 f.s.

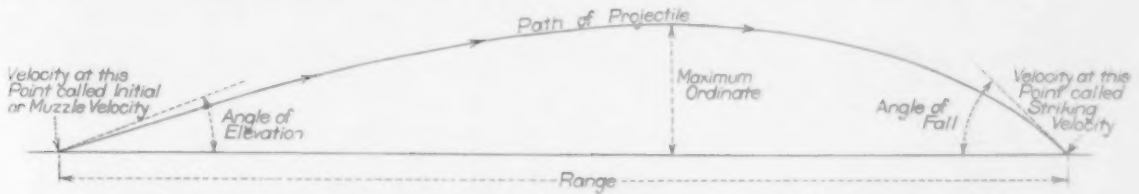

Path of Projectile
Velocity at this Point called Initial or Muzzle Velocity
Angle of Elevation
Maximum Ordinate
Angle of Fall
Velocity at this Point called Striking Velocity
Range

Fig. 9—Direct Fire Trajectory Indicating the Various Elements Acting on the Projectile

It is a general rule that a gun of a certain degree of mobility is the next smaller size in caliber to a howitzer with the same degree of mobility. In permanent inland fortifications, as are found in Europe, artillery of all classes is used—guns, howitzers and mortars.

ACCURACY AND PROBABILITY OF GUN FIRE

No discussion of guns is complete without brief reference to this subject. Guns, projectiles, mounts and powder are not perfect, and small variations in the factors of their design, mentioned in this article, besides certain other influences, such as variations in density of the air, temperature of the air, etc., all act to prevent continuous accuracy. In addition to such influences must be considered the personal factor in estimating ranges and laying the gun, the effect of the wind, etc.

With perfectly aimed shots and ideal weather conditions, the successive shots of a gun will not follow each other but will tend to disperse, all of them for any special gun being within a certain sized cone. The size of this cone is of vital importance. Its cross-section is roughly an ellipse, the major diameter being vertical and the minor diameter horizontal. The center of this area or cone corresponds to the point of aim and is called the *mean point of impact.* Variations in range of from 100 to 200 yd. are easily possible with 12-in. guns at 15,000 yd. It is difficult to generalize on this subject, but an example will be of value. Should a ship make 68 per cent of hits at 1700 yd. range on a target 15 ft. high and 20 ft. wide, she should be only able to make about 12 per cent of hits if the target were moved away at 5000 yd., supposing the same accuracy of fire at both ranges.

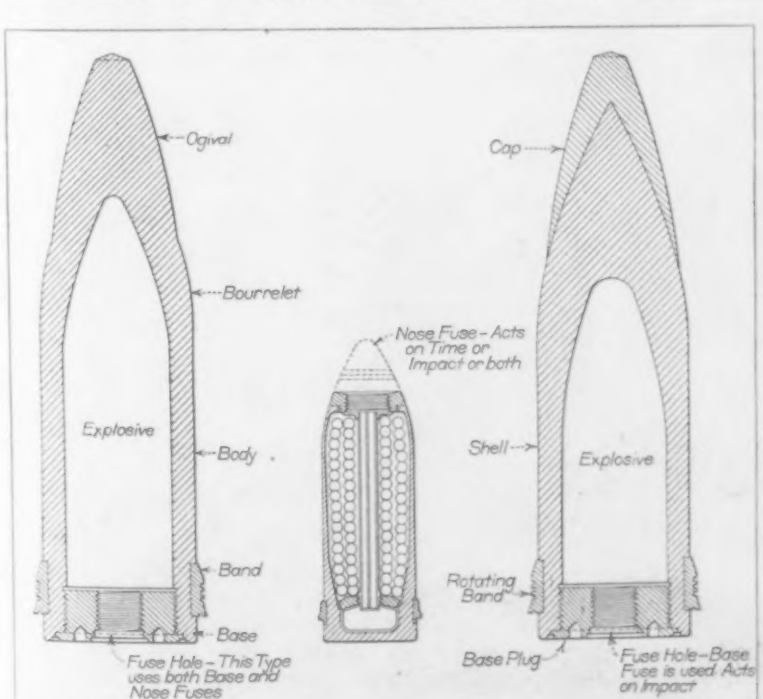


Fig. 10—Types of Projectiles, the High Explosive, Shrapnel and Armor Piercing, from Left to Right

In naval warfare ships, which are comparatively small targets, must be hit, for splashed water is harmless and ammunition supply is limited. Against fortifications the same is generally true, but against intrenchments or bodies of troops volume and dispersion of fire is sometimes more desirable than accuracy. Volume and dispersion of fire even finds use in naval warfare; but, generally speaking, against small craft only.

Popular discussion of the range of guns is quite evident these days. Every gun has a maximum range, of course, but a knowledge of it is of little value. For instance, the American and British 14-in. and 16-in. naval guns have ranges at 45 deg. elevation of between 40,000 and 50,000 yd. They can not be used for such ranges for many reasons, primarily because the probability of hitting an ordinary target is exceedingly small. Such guns can be used with a fair probability of hitting and with reasonably successful fire control they may be used quite successfully at, say, 20,000 yd., and excellent results can be obtained at 17,500 yd.

Future Developments in Methods and Mechanisms

Every war of any importance is a milestone in the development of the implements and methods of warfare. The fundamentals of diplomacy and strategy change very slowly, if at all, but the methods of conducting active operations change to meet every advance in scientific achievement, and in fact lead the way to scientific advance.

Improvements in the mechanisms used in warfare have at times been the dominating factors in some wars. For instance, the Greek fire, introduced about A. D. 668, used by the warriors of the Eastern Roman Empire, probably prevented the conquest of Constantinople and Eastern Europe by the Moslems for several centuries. At Crecy, in 1346, the English were greatly assisted by the use of guns, of which the French had none. Later, the German needle gun, used in the wars of 1864 and 1866, which materially increased the rapidity of small-arm fire, brought material advantage to its users. The adoption of the Chassepôt by the French caused the Germans to readjust their tactics in the war of 1870.

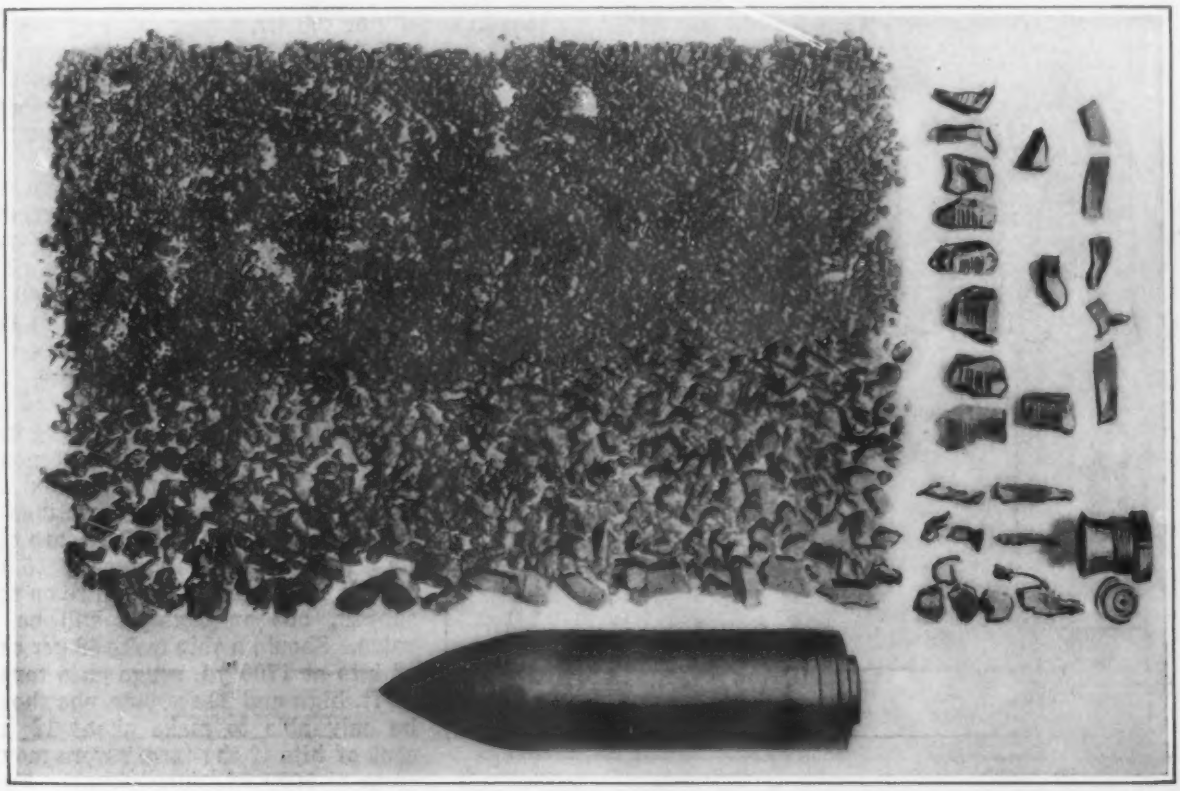
It is quite evident that recent developments in material are again causing modifications of tactics, and the readers of THE IRON AGE will be interested in a brief discussion of that subject. It will be necessary to depart somewhat from the specific subject of artillery, and it should also be borne in mind that the present war is not over and that some of its lessons may not as yet be conclusive.

THE AUTOMOBILE AS A FACTOR

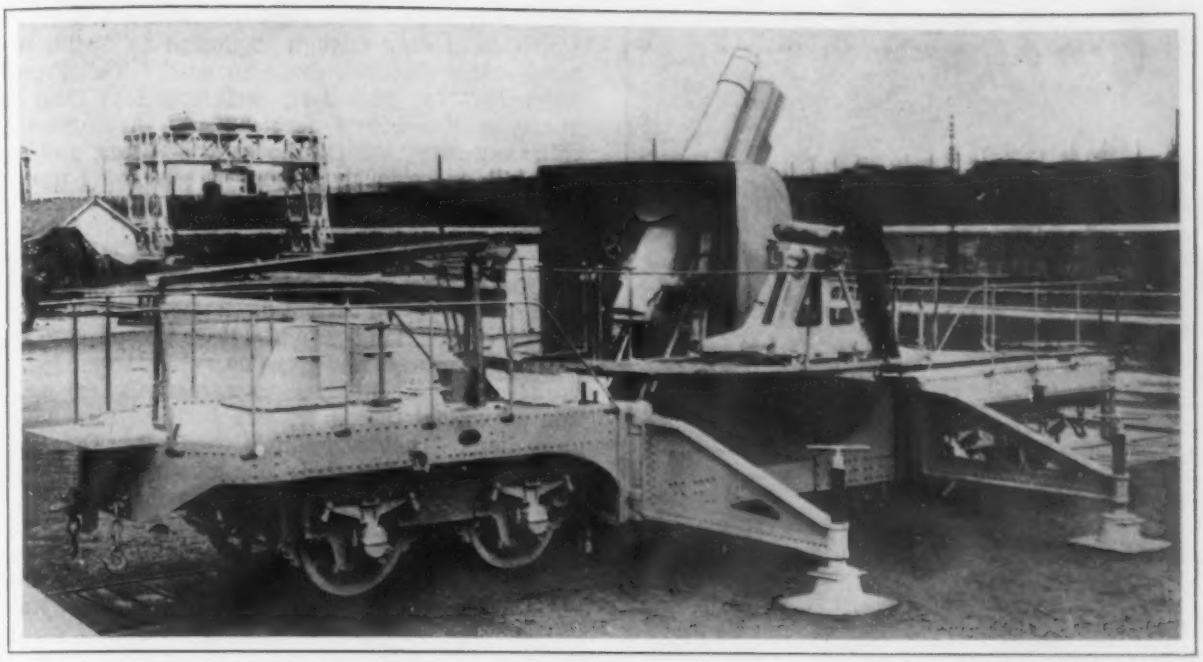
The automobile has had a monumental effect on warfare. In the first place, it has greatly simplified the transportation of ammunition and supplies, thus permitting a more extensive use of artillery and machine guns and the massing of troops. Without railroads and motor trucks the masses of troops being used in the present war could not be put into the field. All the horses in Europe could not handle the field transportation work of such armies, even if drivers and forage could be provided.

This is one of the most important lessons of the war, and it points, in America, to the necessity of our building stronger country bridges than we are now doing. In the second place, having tended to develop good roads, it has opened a new field to the ordnance engineer and he has been able to give mobility to powerful artillery. Howitzers up to 12-in. caliber have been put into the field, and such artillery must now be classed among the mobile artillery. The best example of such artillery is the Austrian 28-cm. (11-in.) howitzer.

Also we find the multiplicity of railroads, their location on strategic considerations and their increase in train loads have opened still another field



Condition of a 3-In. American Common High-Explosive Shell After Passing Through a Steel Plate and Into a Bank of Sand, and After Bursting (Annual Report Smithsonian Institution, 1914)



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One of the 200 Mm. (8-In.) Rapid Firing Howitzers of the French Army, Mounted on a Flat Car of a War Train. The gun and carriage itself is protected by an armored shield. Folding arms swing from both sides of the car to prevent the car from being overturned

to the ordnance engineer, and the modern "railroad artillery," of which the German 42-cm. (16.5-in.) howitzer is practically the only example, is the result. It can not be stated at present that such guns have had deciding influence in the present war, but it can not be denied that their use has secured important results. It should be noted that such artillery has been used so far only against inland fortifications.

The use of such artillery has seriously questioned the usefulness of present inland fortifications constructed of metal and concrete. Such fortifications are useful as bases, for protection against turning movements and as barriers, and it is quite evident that not only must their local protection be improved, but that they should be surrounded with systematic far-flung field intrenchments to keep attacking artillery beyond very effective range.

IMPORTANCE OF INFANTRY

Astonishing as has been the lavish use of artillery in this war, the importance of infantry has been increased rather than diminished by its lessons. The rifle is quite as important as it ever was, and relatively the machine gun has gained a greater importance, by this war, than any other weapon.

Americans are prone to consider the total railroad mileage of their country rather than its local density and strategic location. That factor, as well as the co-operation of our railroads with military authorities, should be considered. The proper transfer of troops and supplies to the scene of operations is the basis of success.

THE AEROPLANE HAS ALTERED TACTICS

The airship has, in its turn, produced decided changes in the conduct of war, perhaps the most decided changes. The dirigible balloon, while having achieved its purpose in sea scouting and to a less degree land scouting and bomb-dropping expeditions, has had small application compared with the aeroplane, which can be said to have revolutionized tactics.

In the first place, aero reconnaissance has practically eliminated large-scale surprise movements, such as extensive turning movements, and gives ample warning of the concentration or arrival of reinforcements. This applies with equal force to land and sea operations. Co-operation between air craft and artillery has enormously increased the efficiency of the fire control of the latter; thus, in effect, increasing its accuracy or, in other words, extending its effective range.

NARROW TRENCHES THE RULE

Aero scouting has further altered the former plan of constructing and locating trenches. Where trenches used to be at least 4 ft. wide they must now be extremely narrow, even 18 in. or 2 ft., as wide trenches are easily detected from above; and they must be separated into groups, for distinct and continuous lines of trenches are more easily discernible.

The primary consideration in locating trenches used to be a field of fire of at least 800 yards, where possible, and invisibility from horizontal view. Now the primary consideration is invisibility from above, and field or fire must be sacrificed, even to the extent of locating behind the military crest or on the reverse slope; and a field of fire of only 100 yd. is considered satisfactory if this object can be secured. Trenches, further, used to be more or less continuous ditches; now, because of the increase in accuracy of artillery fire, the use of high-explosive shell by field guns, and the use of hand grenades and bomb mortars, they must be stepped or jogged, to localize the effect of explosions.

AIR CRAFT AND NAVAL WARFARE

Fire control in naval warfare can be quite efficient at ranges of 15,000 to 17,000 yd., and fairly efficient for ranges up to 20,000 yd. There is no doubt that co-operation between air craft and ship's fire control parties can be developed, and with the perfection of such a system the effective range for naval warfare will be increased, or in other words the accuracy of marksmanship will be improved. It is interesting to note, in this connection, that only the smoke pipes and masts of large vessels are visible to turret gun pointers at about 25,000 yd.

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The Officer at the Telephone, Who Transmits the Orders of the Commanding Officer, Is Protected Against Poisonous Gas Bombs and a Hand Grenade Is Suspended from His Belt

TYPES OF AEROPLANES

Aeroplanes are rapidly being classified into distinct types, just as ships have been. For instance, we have the scout machine, with great speed, long cruising radius and excellent maneuvering qualities; the destroyer, with high speed and good maneuvering qualities but with the cruising radius reduced to permit light guns and armor to be carried; and the fire-control machine, fitted with wireless telegraphy apparatus and given fairly low speed to permit hovering.

ANTI-AIRCRAFT GUNS

The ordnance engineer has been called to further fields by the airships. For defense against air craft, small guns of from 1.5 in. to 3.0 in. caliber have been designed, the requirements of which are high muzzle velocity, elevations of as much as 90 deg., and for land work, in most instances, great mobility. Guns to be carried by aeroplanes have, on account of the shock of discharge and weight, been limited to very small calibers. Recently a 3-in. gun has been produced in America in which the shock of discharge has been eliminated by making it double ended and having it shoot equal weights from both ends simultaneously. One end is a rifled barrel for the regular projectile and the other end is a smooth bore barrel for bird shot. The gun is very light and a fair velocity is given the projectile. The bird shot quickly dissipate and are harmless.

Again, new types of projectiles called drop bombs or grenades have been produced. Small ones weighing from 10 to 50 lb. are provided for aeroplanes, while large ones, weighing from 50 lb. upward are provided for dirigibles. Such bombs are of two types: shrapnel bombs, which, bursting on impact, distribute fragments and small balls more or less horizontally; and detonating bombs, filled with high explosive, which, detonating on impact, destroy by the violence of the detonation. Incendiary bombs, possessing the qualities of Greek fire, which have only enough explosive to ignite and scatter the contents, are also used. The French "flechette" or steel dart, weighing less than an ounce, is also a new development. A single machine can carry several thousand of these, and one will kill or seriously wound a man or horse if dropped only 600 ft.

THE HAND GRENADE AND TRENCH BOMB

One of the most interesting developments of recent times is the revival of the hand grenade and trench bomb. Hand grenades were first used in the sixteenth century, and were so extensively used in the seventeenth century as to warrant the organization of special troops trained in their use, called grenadiers. They were little used after the eighteenth century, but their use was revived in the Russo-Japanese war and extensive use was made of them to good effect by the Russians in the siege of Port Arthur.

As used at present they are cylindrical metal containers, filled with high explosive, weighing, when filled, about 1½ lb., though some weigh as much as 4 lb. They are used in hand-to-hand combat and are thrown from hand slings or sticks into trenches. There are two kinds: those which explode on impact, and those which are caused to explode after a few seconds by means of a time fuse which is lit when thrown by a wrist lanyard or similar device. The use of hand grenades is interesting to America because they can be efficiently used by comparatively raw troops. Hand grenades can be used up to about 50 yd. distance.

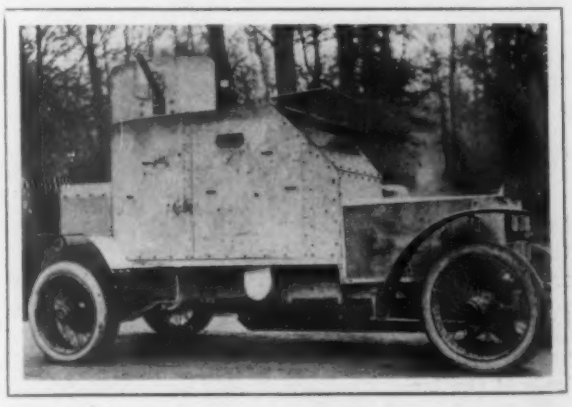
Bomb mortars are small mortars used for throwing larger grenades and high-explosive bombs to comparatively short distances. Ranges up to 250 yd. are thus secured.

Asphyxiating gases, such as chlorine, now being used, are placed by utilizing a favorable wind or by incorporating them in grenades or bombs.

The increased efficiency of artillery fire and the use of grenades and gases have caused elaborate bomb-proofs, etc., to be added to trenches.

SUBMARINES VERSUS BATTLESHIPS

Perhaps the most striking recent development of naval warfare has been the perfection of the attack on submarines. The submarine, while a valuable weapon, is by no means the David of larger war vessels. So far as is known, no large modern war vessel has as yet succumbed to submarine attack, and the lessons to be learned from the present war are more as to the means for their destruction than as to their effectiveness. Submarines have cruising radii of 75 to 125 miles only, under water, and they must come to the surface for offensive



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Belgian Armored Automobile with Machine Gun

work, and, as occasion demands, to recharge their storage batteries and air supply. Sea-going torpedo boats, small steamers and fast motor boats, armed with small guns, and air craft are used to search them out, and steel nets of large mesh have been successfully used to snare them.

NO MATERIAL MODIFICATIONS IN NAVAL VESSELS

Recent events have indicated no material modifications in the character of naval vessels. Many important details are being changed, but the usefulness of all existing types of sea craft has been vindicated. Thus, America's lessons are rather as to the proportion of vessels in the various types rather than as to the creation of new types. At no stage in history has Admiral Mahan's conception of the value of the control of the sea been so forcibly shown as in recent times.

THE CARE OF THE SOLDIER

The care of men is receiving renewed attention. The demands of warfare are ever increasing, and every effort is being made not only to husband the men but to nourish their efficiency by providing for their comfort and cleanliness as much as possible. Thus, in small naval craft of all kinds where the discomforts are many every means is being taken to ease the situation. This means unhampered attention to duty. Again, on land, we see the elaborate, but even as yet inadequate, arrangements for the bathing of men and sterilization of clothing. The revival of personal armor for infantry is an interesting development in this connection.

One of the most important lessons of the present war is the value of industrial organization to a country. As General Wood has said, a trained military force is simply a cutting edge, which must be supported and given direction by all the strength and organization of the nation behind it. Both are necessary, and each is weak in effect without the other. For instance, Rumania is armed mostly with Krupp equipment—many inferences can be drawn from that condition. Of course, no nation can or should develop industry for the sole purpose of backing military forces, but every nation which possesses well-organized metal, glass, chemical, textile and agricultural industries should see to it that, by any means, such can provide *all* the sinews of war *in such quantities as the wisest military counsel may deem advisable.* This appears to have been lost sight of in present public discussion.

SUPERIORITY OF TRAINED TROOPS

The present war appears to have demonstrated to popular opinion what military experts have always known and stated: *the marked superiority of trained troops.* The length of time which "Kitchener's Army" required in training needs no elaboration here. That time was a primary factor in providing a navy has been generally acknowledged, but never before in our day has the time factor in the preparation of an army been so clearly demonstrated or so widely acknowledged. The power using trained troops secures the initiative and forces on its adversary the necessity of providing preponderance in numbers.

The necessity for and adherence to an adequate military policy and the preparation of industry to meet its demands are the primary lessons of the war, and with our growing population and foreign trade it behooves us to change our discussion of such lessons into action.

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Deserted Russian Trenches in East Prussia

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This Captured War Aeroplane Has Special Arrangements for Dropping Bombs Through the Bottom, Which the Soldiers Are Examining

Large Shells of the United States

The projectiles thrown from battleships or from shore artillery of the United States army and navy were shown as a part of the United States Government exhibit in the Palace of Machinery of the Panama-Pacific International Exposition at San Francisco. The projectiles used in the coast-defense guns are known as armor-piercing and deck-piercing shells. The first are used in direct-firing guns, while the second are fired from mortars. Both varieties are made from forged steel. The caps or points of the shells are made from soft steel to prevent the shell from glancing, to offer less resistance while flying through space and to lessen erosion in the bore of the gun as it is hurled forward. This style of cap is known as a ballast cap. For target practice cast-iron shells are used. Shells are painted with a band of gray to indicate the forged steel shells and green to designate the cast-iron ones.

The largest shell was a 16-in. cast-iron shot made to fit the largest gun in service in the United States, of which there is only one, now at Sandy Hook, N. J., but which will be mounted in the Panama Canal Zone. This shell weighs 2400 lb. and requires 666.5 lb. of smokeless powder to propel it. The smallest shell shown was an 8-in. armor-piercing shell weighing 323 lb. and requiring 83.5 lb. of explosive to carry it.

Morgan Park—A Beau

The "Model City," Built by the Mi
Natural and Artificial Attractiv

IT is human nature to look askance at what is out of the beaten path. The building of a steel works at Duluth had suggested the possible difficulty of securing and preserving an operating organization, largely for the reasons that Duluth is distant from other steel mill communities and is located where the accustomed lack of sustained employment in one occupation had made for a migratory common labor. As a matter of fact, those in the past who have gone from the lower lake districts to the iron-ore country have found for those attributes which may be wanting, many compensating advantages. Some of these advantages the Minnesota Steel Company has capitalized in a maximum degree in the location of its mill site and particularly in the laying out of a town for the housing of its mill employees engaged in advanced positions.

Morgan Park, where the mill superintendents, assistants, foremen, bosses and the skilled labor will live, is laid out on the high ground overlooking Spirit Lake and the St. Louis river and lies sheltered under the still higher bluffs that rise, commanding and picturesque, to the west. The country wide offers but few residence sites more attractive than this, with its far view of the winding river and the nearer island-dotted lake. Even the steel mill on the high ground beyond the intervening valley, its tall stacks rising against an unfamiliar background, is a picture that would yield much to the stroke of Pennell's crayon. Certainly no other mill location can offer surroundings comparable in natural attractiveness, nor, in the summer at least, weather conditions so desirable. In the laying out of the town and in the attention to exterior appearance, as well as serviceability of the houses, the builders have happily made the most of their opportunities and there can be little doubt that Morgan Park itself will contribute much to the contentment of the mill organization.

The boulevard which skirts the lake winds up the hill and divides into two encircling roadways, the uninterrupted view from which suggests the location of the higher-priced houses. But from almost any spot in the town there is an attractive outlook. All of the streets are comfortably wide, paved with concrete and flanked with grass parkways in which are planted the ash, elm, birch and maple trees, native to the place. The lots are of sufficient frontage to permit ample lawns on all sides of the houses around which shrubbery is also generously planted. Allowance has been made in the water supply for a plentiful watering of lawns, gardens and shrubbery. The business thoroughfare and main traffic artery through the town is a north and south median line through the entire town-site of about 180 acres, but thus far only about one-fourth of this area on the east side of this street has been built up. This avenue is nearly 60 ft. wide with a central boulevard in which car tracks will be laid. In this street all business will be segregated, the business blocks being set back from the street with lawns and trees in the same manner as the houses.

The residences all face on the north and south streets, which are spaced at intervals of 266 ft., sufficient for two lots 125 ft. deep with a common alley, 16 ft. wide, between. These alleys are also paved with concrete and pitched for drainage, so that they may be washed down and kept clean and sanitary. A system of garbage collection is provided for. All wiring is underground and the streets are electrically lighted, 100-watt tungsten lamps being placed every 200 ft. Several acres of ground have been set aside for playgrounds and athletic sports, and a community clubhouse is to be built.

At the present time 200 houses, sixty-five flat

Dwellings for Two Families, Showing How Porch and Roof Designs Leave Little Superficial Similarity, Though Inside They May Be

tiful Steel-Mill Town

nesota Steel Company, Unique in ness—Design of Houses Detailed

buildings and four boarding houses have been constructed. In this number are included fifteen types of building, the five to eight-room single family dwelling, the flat building for two, four and six families, and the boarding house which accommodates up to forty men. The accompanying illustrations show that in external arrangement there is sufficient variation in size, in the contour of roofs, staining of shingles and arrangement of porches to dissipate that monotony of appearance characteristic of most mill towns. In the design and construction of the houses attention has been particularly given to making them fireproof, exceptionally warm and weatherproof, as well as promising of very low maintenance cost. The only detail of construction not distinctly fireproof is the roof of white cedar shingles. The building walls are constructed with concrete blocks of special shape, the floors are of hardwood laid over reinforced-concrete. The equipment of the houses includes electric light, gas for cooking, hot-air heat and grate fireplaces, bathrooms and kitchens with sanitary plumbing, and laundries. The interior trim is birch and for the windows storm sash are supplied.

In view of the somewhat specialized construction adopted for these buildings, as well as their peculiar fitness for mill or mining towns, the accompanying table of actual costs is interesting. These costs cover the houses complete with all hardware, fixtures, plumbing and window shades. The symbols opposite the cost figures designate the types of houses with reference to number of rooms and number of families. For example, 44-A indicates one arrangement of four-room, four-apartment building in terrace, while 16-A indicates a single family six-room house. The total cost of the buildings thus far erected is, in round numbers, $957,086. The accompanying plans illustrate three principal types of building.

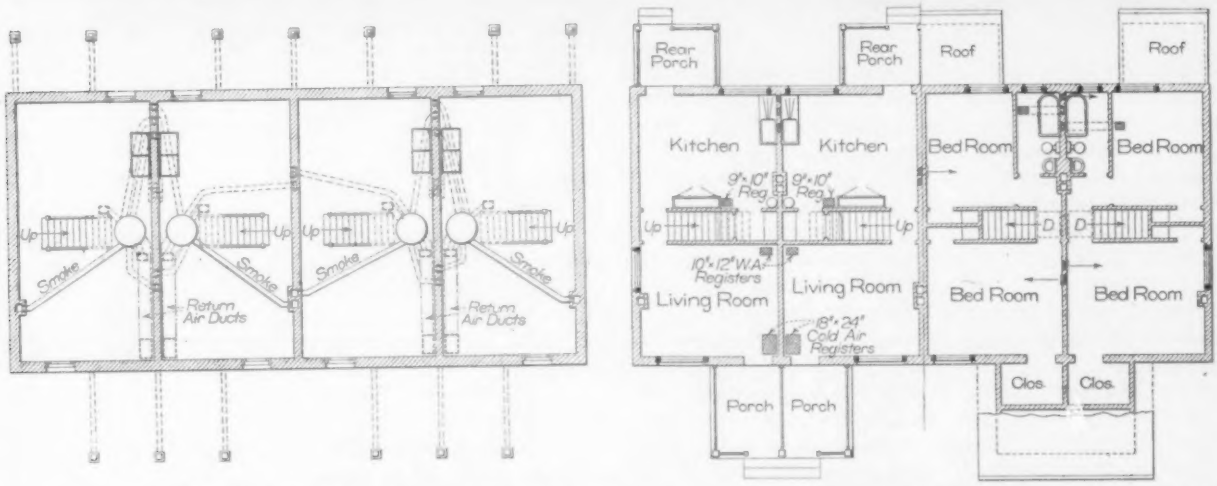
Table of Costs

Dwellings		Dwellings	
Type of House	Cost	Type of House	Cost
44-A	$8,575	18-A & C	$5,723
64-A	12,057	18-B & BR	5,461
15-A	3,367	Flat Buildings	
15-B	3,330	445,-A	10,175
16-A	3,615	24-A	5,279
16-A	3,720	24-B	5,286
16-C	3,788	25-A	5,701
16-D	3,681	25-B	5,702

From the standpoints of permanence, low maintenance cost, serviceability and ease of erection per dollar of building cost, the construction of these houses has a wide adaptability. We, therefore, reproduce construction drawings in sufficient detail to set forth the design as prepared by the architects, Dean & Dean, Chicago. These drawings require but little explanatory comment. The boarding houses involve all of the features to be found in the various types of houses and referring to these drawings attention may be called to the wall construction, the concrete floors and the heating system.

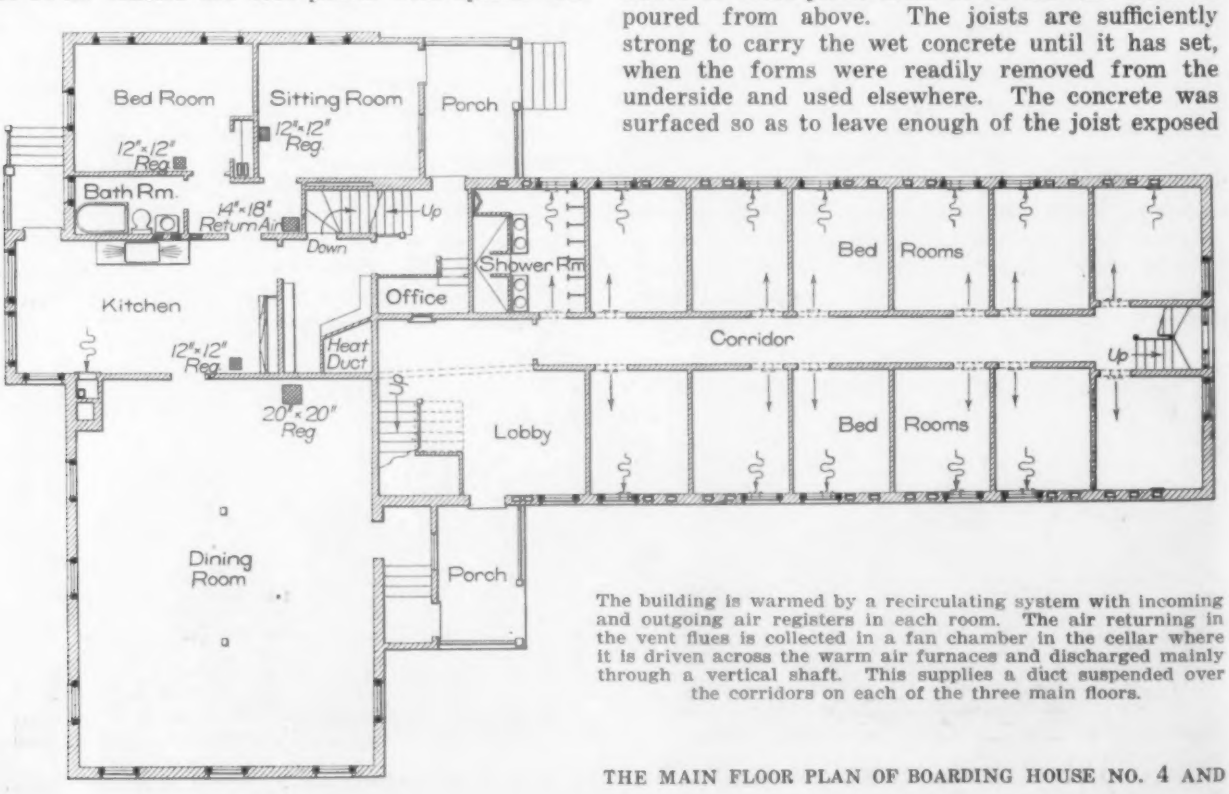
The walls are laid on concrete footings from 54 to 57 in. below grade line, and are constructed of T-shaped concrete blocks, as shown in the accompanying cross-sections. Below the ground line the wall is laid with two rows of blocks, staggered and reversed with respect to each other, the arrangement forming continuous vertical air passages and partial connection horizontally. Above the ground line but one block is used. Upon the inward projecting legs of the blocks a thickness of heavy building paper is laid and held there by furring strips approximately 1 in. thick. On this furring plasterboard is then laid and covered with the cement plaster. A double air space is thus provided which, in the experience of one winter, has proven highly effective in maintaining the interior temperature.

Single Family Houses, of Different Sizes but Which When Identical in Room Arrangement Are Differentiated by Roof Design



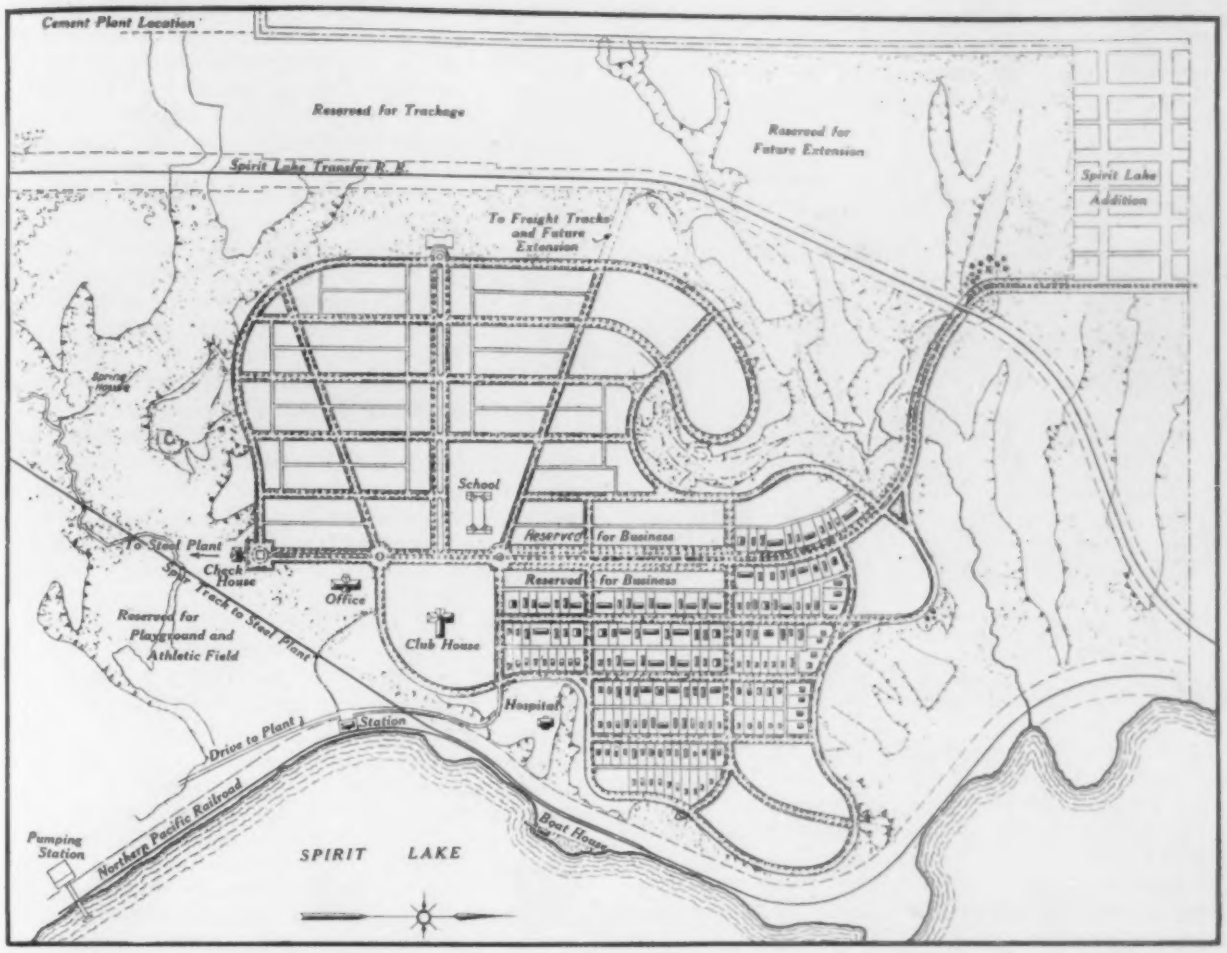
A Four-Family House and the Typical Room Arrangement. The cellar plan shows the four independent areas, each with its own warm-air furnace and laundry trays. The first floor plan for a half of the building is shown and also a second-floor half plan

All floors are of reinforced-concrete overlaid with hardwood. Timber joists 2 x 6 in. and spaced at 16-in. centers are first placed with special concrete blocks inserted between the wall blocks to support them. The forms for the concrete were then nailed to these joists from below and the concrete poured from above. The joists are sufficiently strong to carry the wet concrete until it has set, when the forms were readily removed from the underside and used elsewhere. The concrete was surfaced so as to leave enough of the joist exposed



The building is warmed by a recirculating system with incoming and outgoing air registers in each room. The air returning in the vent flues is collected in a fan chamber in the cellar where it is driven across the warm air furnaces and discharged mainly through a vertical shaft. This supplies a duct suspended over the corridors on each of the three main floors.

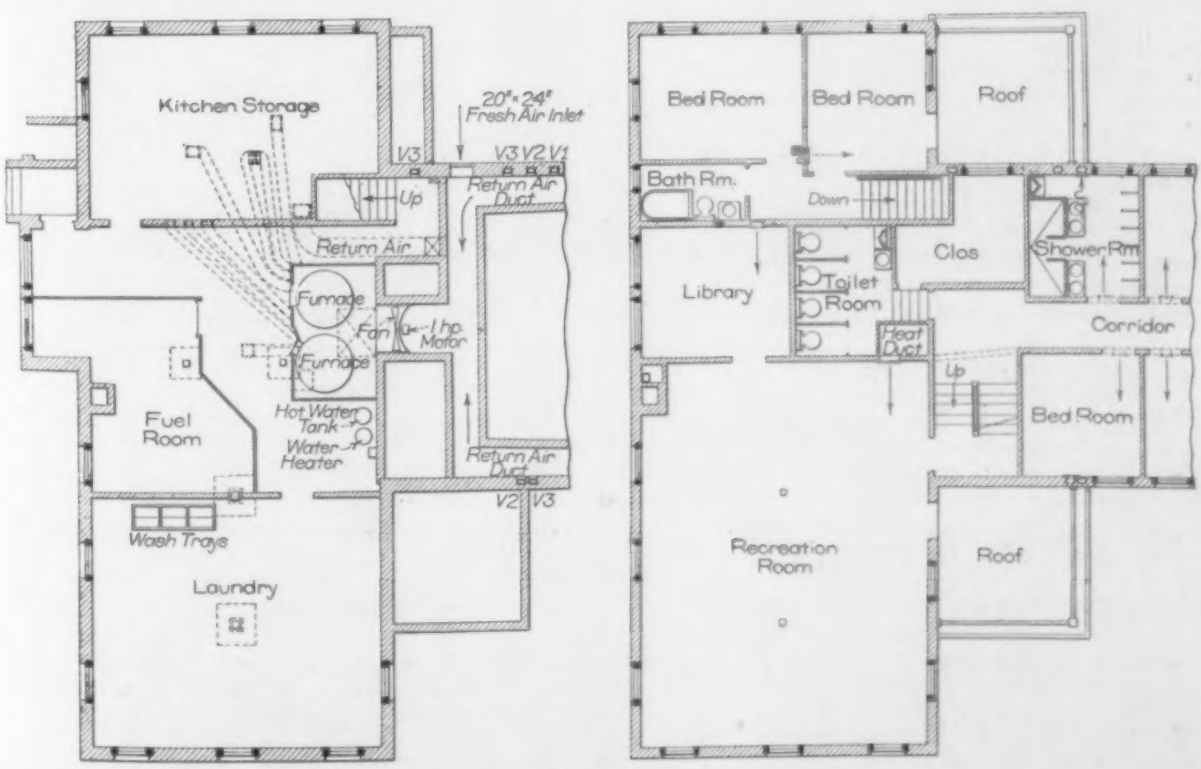
THE MAIN FLOOR PLAN OF BOARDING HOUSE NO. 4 AND



Morgan Park, South and West of Which Are the Plant of the Minnesota Steel Company and the Duluth Plant of the Universal Portland Cement Company

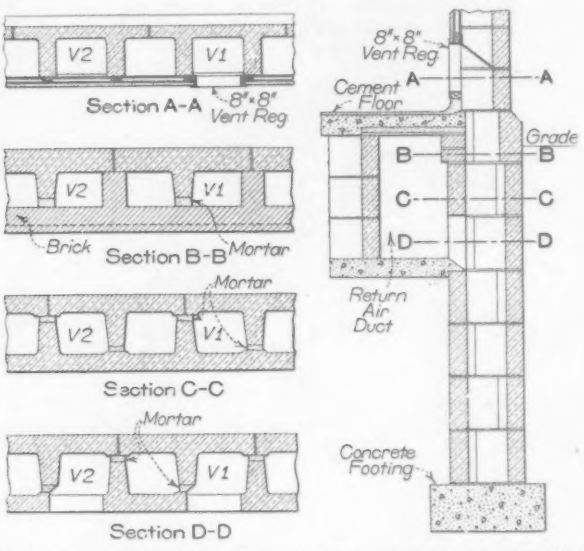
to serve as studding upon which to nail down the wood flooring. In the accompanying details the cross-section of this floor is shown.

In the heating system advantage has been taken of the hollow walls. A positive circulation, hot-air plant is installed with a motor-driven suction fan to maintain the air current. The hot air is taken off from the furnace through a galvanized iron riser lined with wall board. At each floor a similarly lined flue is taken off centrally with respect to the building and carried directly below the floor the full length of the house. Into each of the bedrooms,



PART PLAN OF CELLAR AND PART PLAN OF SECOND FLOOR

arranged along the halls, a register opens from the hot air duct near the ceiling of the room. From the opposite side of the room in the outside wall at the floor is another register opening into the return



The Sections Show How Flues Are Formed for Conducting the Air for Heating and Ventilation

duct which is formed by sealing up with cement one of the vertical passages in the wall. The return air passages from each of the rooms terminate at the bottom in a horizontal passage built against the wall from which at a point opposite the furnace a connection is made to the fan and thence to the furnace. Duplicate units are placed in the boarding houses, one for each side of the building. For the single dwellings an ordinary installation suffices. In the arrangement of these dormitories a feature is the complete isolation of the living quarters of the house manager from the remainder of the house.

Tests of Shaft Grinding Surface Speed

H. H. Asbridge, Churchill Machine Company, Ltd., Manchester, England, in a recent number of the London *Engineer*, gives an account of some tests made by him to determine the best work surface speed for grinding mild steel shafts of various diameters. The shafts ground had a carbon content of 0.35 per cent and ranged from 1½ to 6 in. in diameter and the conditions were kept as nearly constant as possible, the character of the finished surface secured not being given consideration.

The tests were carried out on a self-contained motor-driven plain grinding machine provided with independent motors for driving the work and the wheel during the tests. Ammeters having the dials calibrated to read directly the horsepower required by each of these motors were connected in the circuit. It was the intention to record the power consumed by each motor, but it was found that the difference between the work drive running light and when cutting was so small even on the large diameters that it was neglected.

To keep the cut constant the wheel, which was 26 in. in diameter with a 3-in. face and had a surface speed of 6000 ft. per minute, was brought directly against the work and the cross feed was operated to maintain the horsepower input to the motors constant during the time required for making the test. The figure determined upon was 10 hp. above the amount required to drive the wheel when no grinding was being done. Work surface speeds of 20, 40 and 60 ft. per minute were approximated as closely as possible, the actual rates obtained being given in the accompanying table. In making the tests no transverse motion was used.

The tests were made in duplicate in all cases and the grinding wheel was trued frequently to maintain the face in as constant a condition as possible. In the results given in the table, the amount of material removed is the average of the two tests and it will be noticed that the efficiency is also given both for each diameter of shaft in relation to the surface speed employed and the material removed and also for the range of shaft diameters.

From an examination of the table it is apparent that the efficiencies obtained in each test are the highest for the highest work speed employed and are very consistent throughout the range, the 4-in. shaft being the lowest, while the efficiency at the slower speeds falls off consistently as the diameter of the shaft increases. This indicates that with small diameters the work speed does not exert any considerable effect on the ultimate result, the higher speed being of course preferred. With the larger diameters, however, the correct work speed is of much more importance and a surface speed of 60 ft. or over per minute would apparently be the most efficient.

The employment of women as machinists has been successful beyond expectations in the munitions factories of William Beardmore & Co., Ltd., in Glasgow, according to the *Engineer* of London. Some 800 in all are so employed. In one case where there are 300 girls 60 men are needed for tool setting, setting up work and other cases where strength is required. Some of the women have been at the work since May, 1915. Women superintendents are in charge day and night, an attractive dining hall is provided and a quarter of an hour is allowed each afternoon for tea provided by the firm. Not only are products turned out to gage, but the average output is reported wonderfully high.

Diameter of Shaft Tested, In.	1½			2			3			4			6		
Surface speed, ft. per minute	42	31	23	56	42	22	63	33	19	61	44	19	65	38	22
Speed, r.p.m.	106	80	58	106	80	42	80	42	24	58	42	18	42	24	14
Material removed per minute, cu. in.	1.067	1.040	1.040	1.047	1.047	0.958	1.037	0.944	0.756	0.930	0.810	0.670	1.051	0.771	0.507
Power absorbed by cut only, hp.	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Efficiency for each diameter of shaft, per cent.	100.0	97.0	97.0	100.0	100.0	91.5	100.0	91.0	73.0	100.0	87.0	72.0	100.0	73.3	48.2
Efficiency over the range of shafts, per cent.	100	97	97	98	98	89	97	88	70	87	76	63	98	72	47

Washing Blast Furnace Gas at South Chicago

Use of Clean Gas Exclusively Establishes New Practice and Effects Striking Economies—The Method of Washing Total Gas Yield

THE tonnage of pig iron produced by the blast furnaces at South works of the Illinois Steel Company is the largest made by any blast furnace plant in the country. This plant is also the only one where all of the gas produced by the blast furnaces is thoroughly washed.

The plant consists of eleven blast furnaces which produce 500 to 600 tons of pig iron per day. At the present time all the stacks are in blast, making an actual aggregate daily production of 6000 tons. The gas yield is no less impressive, amounting to 605,000 cu. ft. per min., or 871,200,000 cu. ft. per day. These enormous outputs are effected with a coke consumption averaging well under 1900 lb. per ton of iron over the year, and some of the furnaces are doing better than 1800 lb., month after month. In spite of this low fuel consumption, the furnaces which are blown with steam engines supply to other parts of the plant approximately 30 per cent of the gas which they generate, and the gas-blown furnaces have a net surplus of 45 per cent. This surplus gas from the blast furnaces produces, from the boilers under which it is fired, approximately 20,000 bhp., and in addition, 6000 kw. is generated in gas-electric engines. Four of the furnaces are at present blown with gas engines and the remainder with steam eingines. Additional gas engines are being installed to take care of three more furnaces.

This remarkable showing may be credited very largely to the complete gas-washing system which has been installed at this plant. Thoroughly-cleaned gas makes possible the carrying of uniformly high blast temperatures with a minimum consumption of gas in the stoves. A decrease in the coke consumption without unduly lowering the amount of surplus gas available naturally follows. In addition, the use of washed gas under boilers has resulted in a large increase in boiler efficiency, so that more power is generated from a given amount of gas.

The gas cleaning system in operation at South works is the outcome of years of development, in which advantage was taken of experience at this plant, as well as at other plants in this country and abroad. In its present state this system radically differs from others in that the washing is carried farther with respect to the volume handled per washing unit, and to the degree of cleanliness. It differs, also, in the fact that no kinetic apparatus is employed to accomplish thorough cleaning except for that portion of the gas refined for use in gas engines.

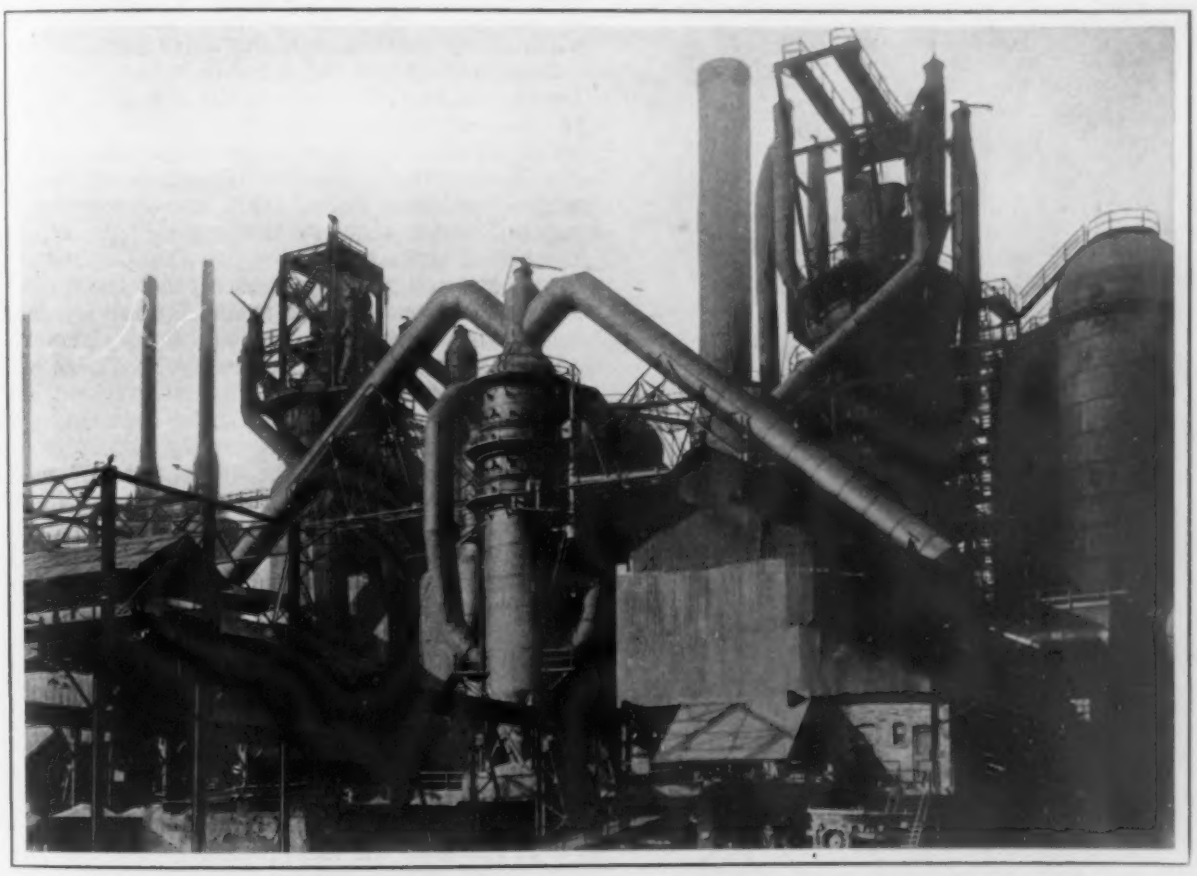


Fig. 1—One of the Large Gas-Washing Towers Which Serves Two Blast Furnaces. The large pipes close to the tower are the dirty gas mains from the whirlers and the pipes branching from the top are the clean gas mains to the dryers

As at most other plants, the first experience with gas washing was gained through the cleaning of engine gas, which was accomplished in hurdle towers followed by Theisen rotaries. In these washers the gas is purified to the highest degree, but the cost is too great to permit of their adoption for washing the stove and boiler gas. By substituting rotary fans or disintegrators for the

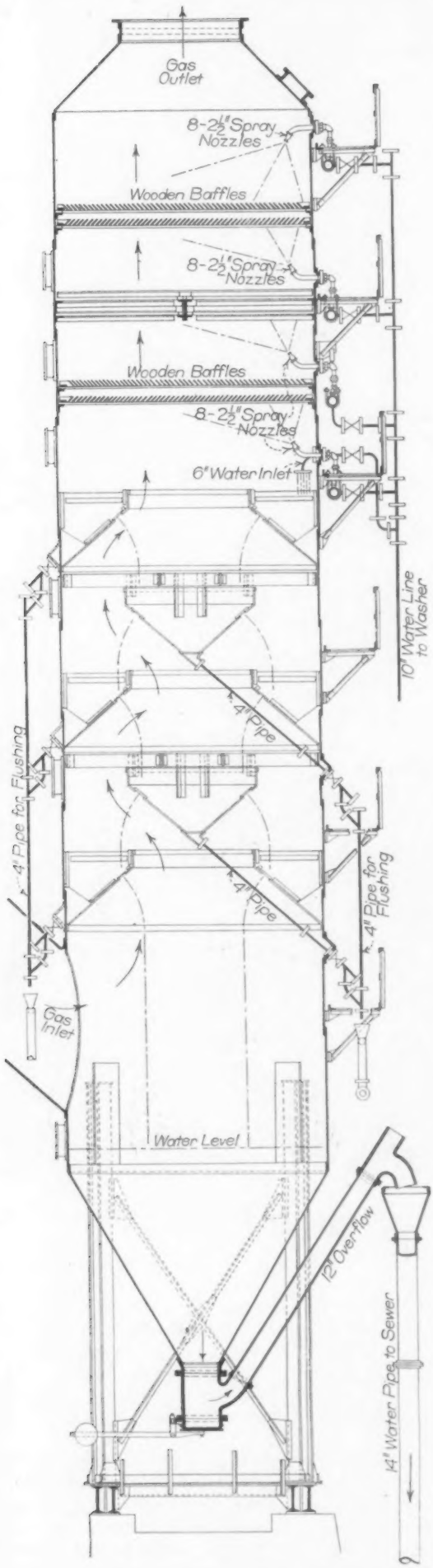


Fig. 2—Cross-section of the Large Washer, the Form of Which Is Somewhat Modified in the Single Furnace Tower

Theisens, the cost of cleaning can be considerably lessened, and gas cleaned in this manner is extensively used, particularly abroad, for stoves and boilers. Fans are used in this country for the purpose of propelling the gas and, also, as a second stage, following single-stage rain towers. In most cases the power required for driving these fans is greater than that for supplying the water to the washers.

The advantage of washing all the gas was early recognized, but it was also realized that in order to handle such a large volume a cheaper, simpler and more reliable operating proposition would have to be devised than is represented by a large number of rotary machines which consume a great amount of power, are expensive in repairs and upkeep, and introduce a certain element of danger and complication due to the suction created in the gas mains from the furnaces. But it was clearly understood that to derive the full benefit from washed gas in stoves and boilers, it must needs be thoroughly washed.

Experiments with empty, spray towers as well as Zschocke towers had not given satisfactory results. They merely proved that a far more intimate contact between gas and water is required than can be obtained by such simple means, and that in order to effect this the gas and water must be finely divided, giving to every minute particle of dust in the gas the opportunity to come into intimate contact with a particle of water. This thorough mixing of gas and water requires time as well as a large number of contact surfaces. In the simple spray tower, gas and water pass each other too quickly, and there are no positive means for forcing them into intimate contact. Stratification, channeling and incomplete washing are the results. Even with Zschocke towers which contain small vertical hurdles, distributed over a large tower area, and with principal surfaces arranged parallel to the flow of gas, experience showed the distribution of water and gas to be undependable and the contact insufficient, while the gas still retains dust in sufficient quantities to cause considerable trouble from the clogging of gas conduits and burners. It was likewise found that the cleaning of stoves could not be entirely eliminated.

The solution of this problem immediately presented a difficulty. Reducing the size of the passages for the dirty gas and thereby dividing it into many small streams, results in part of the openings becoming closed with accumulations of dust, while the velocity in the rest is increased, the distribution becomes poor, and the very object aimed for is defeated. In consequence, it was concluded that in order to accomplish thorough washing in a stationary apparatus, it is necessary to divide the work into two stages, a first or rough cleaning stage designed to eliminate the heavier portion of the dust, and a second stage calculated to effect the fine cleaning.

This method, known as the Brassert two-stage system, employs a single vertical tower, designed to handle the entire output of gas from one furnace. Into the lower half of this tower a heavy rain of water is introduced, the water being redistributed by screens, perforated tray sections, and grids or hurdles, arranged to avoid the possibility of clogging. The upper section contains inclined baffles, arranged to intercept the flow of the gas, and, through a strong impinging action, to insure a positive contact of the gas with the baffle surfaces. This tower, as installed on several furnaces at South works, is shown in Figs. 1 and 4.

Fig. 3 shows the latest design of this tower as

adopted at South works and a number of other plants. It will be seen that in this latest tower the dirty gas, entering the large open space at the bottom, meets a heavy shower of water from the hurdles above and becomes thoroughly wet. Turning upward through the hurdles, it is then compelled to redistribute and to flow through concentric openings formed by circular tray sections which also serve to redistribute the water and to eliminate any variation in the volume of water descending in any cross-section of the tower. In entering and leaving these tray passages, the gas passes through heavy showers of water which fall from the perforated trays. It then enters another hurdle section, which ends the first or rough washing stage.

In the second stage the gas impinges against three, successive, double rows of inclined, wooden baffles, which are at an angle set to insure the maximum impinging effect and yet not cause excessive back pressure. The narrow passages between these baffles are kept from clogging by a specially designed system of spray nozzles which throw the water against the under baffle surfaces so that the water is carried upward with the gas, through the interstices. All of the water being added in this second stage, the counter-current principle is utilized to the fullest extent. The hot, dirty gas meets the warm, dirty water at the bottom of the tower, and ascending, gradually gives off its dust content and heat to the descending water, until at the top of the tower it comes in contact with cold, clean water. The temperature of the gas as it leaves the tower is within a few degrees of the entering water.

Owing to the positive means of distributing gas and water, the height of these towers can be comparatively low and the diameter relatively large. With this low head, a considerable saving in the cost of pumping water is possible, and, at the same time, a low velocity of the gas at the top of the tower is assured, with the likely result of carrying over a minimum amount of entrained water.

The subsequent drying of the gas is, however, considered a vital necessity. Each washing tower is accordingly followed by a dryer. For drying the gas, a method similar to that employed for fine washing is pursued, viz.: the gas is compelled to impinge against baffle surfaces, but in order to permit the intercepted water to escape promptly from the path of the gas, these baffles are placed vertically in the horizonal shell of the dryer. This dryer is known as the Brassert dryer, and its most generally adopted form is shown in Fig. 5. One distinctive feature is the arrangement of the spray, which can be controlled from the outside, and another, the design of the bottom, which is arranged so that no accumulations can collect and so that the water entrapped can discharge continually without clogging.

The drying elements are spaced to augment the impinging action of the gas in succeeding sections. The flushing is generally done once a day and only one section at a time, so that a minimum amount of water is carried over during the flushing periods. In fact, it is found that the last sections do not need to be flushed except once or twice a week. Fig. 6 shows the standard form of dryer as installed on most of the furnaces at South works and on a number of other stacks.

A modification of the dryer, used on some of the stacks at South works where lack of space did not permit the installation of the standard horizontal dryer, is arranged in vertical form. In this vertical dryer the centrifugal action of the gas is utilized first. The gas passes through double rows of vertical slats or baffles, identical in form and purpose with those contained in the horizontal dryer.

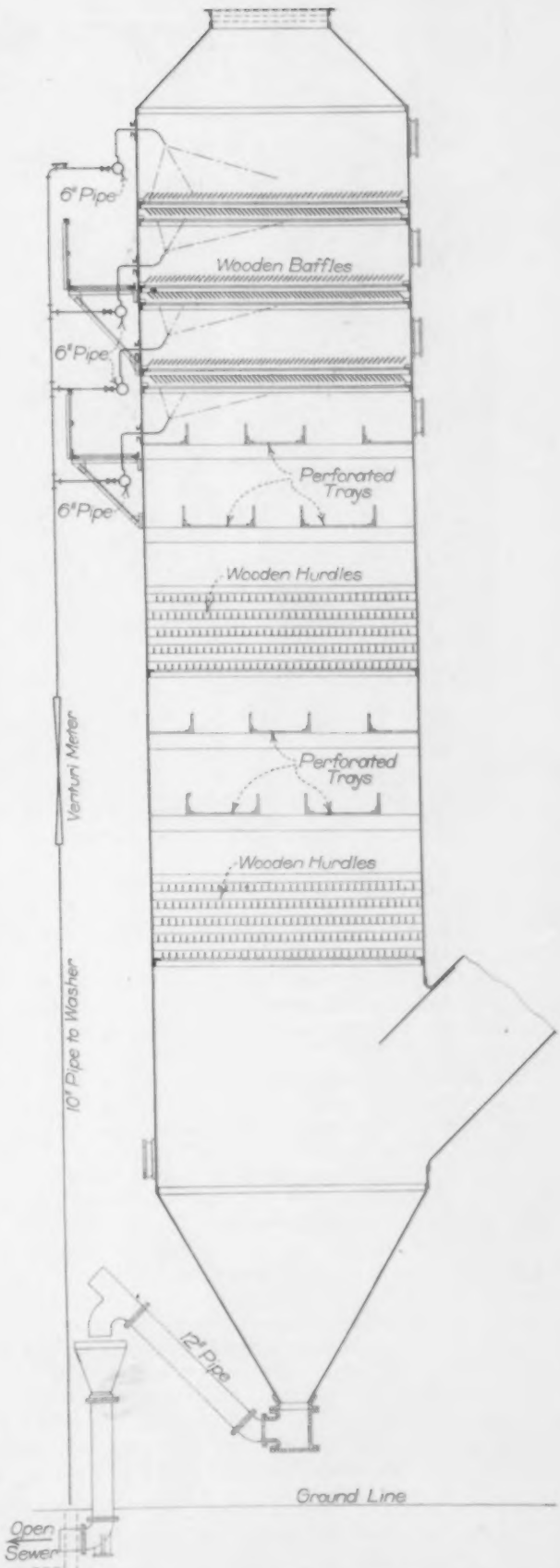


Fig. 3—Cross-section of the Standard Type of Gas Washer with the Distribution of Gas and Water Such That the Height is Comparatively Low

Fig. 1 shows the general arrangement of washer and dryer with reference to the blast furnace. In the pipe connecting the washer with the dryer, as well as in the dryer itself, additional cooling of the gas is effected, causing condensation of moisture, which is eliminated by the drying elements with the entrained water, thereby lowering further the mois-

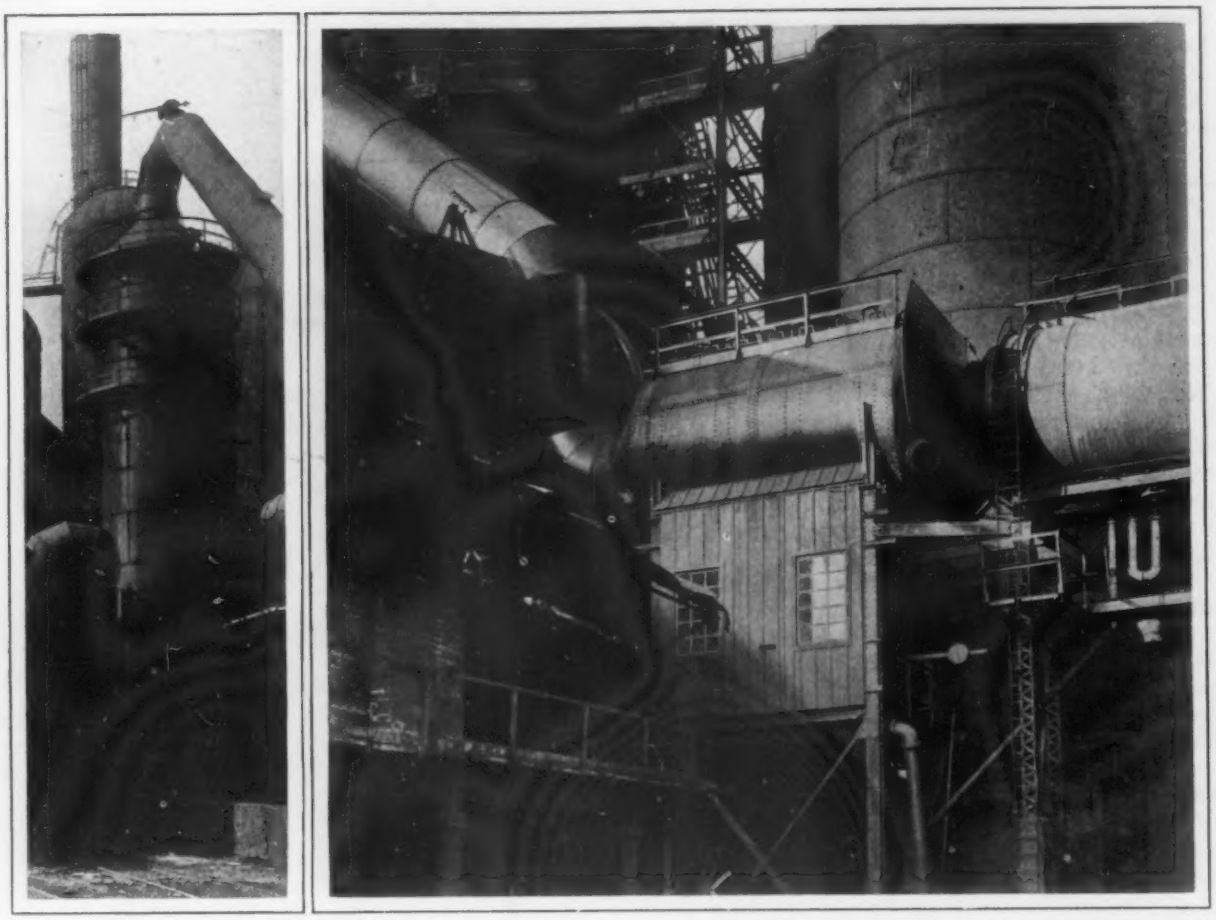


Fig. 4, at Left, is One of the Gas Washers at South Works of the Type Shown in Cross-Section in Fig. 3. Fig. 6, at the Right, is One of the Dryers Installed at South Works Showing the Gas Connections and the Manner of Mounting

ture content of the gas, particularly in the fall and winter seasons.

The washer proper needs no attention. The details of baffle and distributing elements are designed so that all surfaces are flushed automatically and continuously, while the bottom forms a gas seal with automatic discharge of the waste water. The water consumption is low, 20 to 22 gal. of water per 1000 cu. ft. of gas cleaned sufficing in the case of most of the towers. Bosh water is used almost exclusively. It is collected by gravity flow in receiving tanks, from which it is lifted to the top of the towers by motor-driven centrifugal pumps.

The test results shown in the accompanying table indicate in what degree cleanliness is secured in the gas washed in this manner. These tests were made on the gas washing system on furnaces No. 4 and E, each furnace having a 15-ft. washing tower from which the washed gas passes to a pair of dryers arranged in parallel and common to both furnaces. The tests were taken in the dirty mains leading from the dust catcher to the washer and in the clean gas main from the dryer.

THREE STOVES PER FURNACE

From the standpoint of economies effected, a most important improvement in connection with the gas washing system at South works is the development of stove and boiler practice. A number of stoves are now being re-lined at this plant, leaving, temporarily, only three old stoves available on some of the furnaces. Notwithstanding, 1200 deg. Fahr. is being consistently carried, a temperature which is 400 deg. higher than could be obtained with the same three stoves on dirty gas. With the furnaces operating on four stoves, 1400 deg. Fahr. is always available from clean gas.

The reason for this remarkable increase in the capacity of existing stoves is that with the checkers remaining perfectly free and open, the correct distribution of both gas and air in the stoves is preserved, and all of the heating surface is available for the heat exchange. Furthermore, as the brick surfaces do not become coated, the heat transfer remains highly active and is accompanied by a maximum penetration. As more heat is absorbed by the brickwork, less is wasted in high chimney

Results of Tests, November, 1915, on Gas Washing and Drying System at South Works, Illinois Steel Company

Furnace No. 4 (Raw Gas Entering Washer)			Furnace E (Raw Gas Entering Washer)			Furnaces No. 4 and E (Clean Gas After Dryer)		
Day	Time	Gr. Dust per Cu. Ft. Dry Standard Gas	Day	Time	Gr. Dust per Cu. Ft. Dry Standard Gas	Day	Time	Gr. Dust per Cu. Ft. Dry Standard Gas
11	2.30- 3.20	13.76	6	9.40-10.40	9.16	17	1.15- 2.15	0.083
11	3.35- 4.35	18.10	8	10.35-11.35	9.36	17	2.30- 3.30	0.115
12	9.25-10.25	14.79	8	1.40- 2.40	17.75	17	3.35- 4.35	0.029
12	10.35-11.35	15.19	8	3.10- 4.10	29.79	18	9.15-10.15	0.149
12	1.20- 2.20	12.20	9	9.25-10.25	4.74	18	10.35-11.35	0.149
12	2.35- 3.35	9.97	9	10.45-11.45	6.88	19	9.30-10.30	0.114
13	9.30-10.30	13.60	9	1.35- 2.35	4.89	19	10.35-11.35	0.114
13	10.30-11.30	19.30	9	2.50- 3.50	8.01	19	1.30- 2.30	0.110
13	11.40-12.40	24.10	10	9.05-10.05	9.62	19	2.40- 3.40	0.081
13	12.50- 1.50	13.70	10	10.25-11.25	7.47	19	4.00- 5.00	0.093
13	2.00- 3.00	27.40	10	1.25- 2.25	6.68			
			10	2.40- 3.40	9.78			
Average		16.55			10.34			0.105

temperatures and the stove efficiency is increased. A number of stoves are lined with 4½-in. checkers, and inspection of the stoves shows not a trace of dust has been deposited on the checkers after one to two years of operation.

The stoves which are now being re-lined at this plant have checkers only 3½ in. square, and the heating surface in the same stove shells is more than doubled in comparison with the former linings. In fact, three stoves with 3½-in. checkers will have one and one-half times the heating surface of four of the old stoves with 9-in. checkers. In view of this extraordinary increase in heating surface, the stove operation at South works is gradually being placed on a three-stove basis, which accomplishes a saving in stove equipment, including valves and accessories, decreases radiation loss and leakage and saves operating labor.

IMPROVED STEAM BOILER PERFORMANCE

The boiler practice is equally noteworthy because of the complete elimination of dust deposit in the combustion chambers and on the boiler tubes. It has become possible to maintain a course of checker work in front of the boiler tubes, thereby intensifying combustion, with the result that even where old burners are used a much higher boiler efficiency is reached. The burning of coal for pilot fires is no longer necessary; in other words, absolutely no coal is being used on the boilers fitted for gas.

On a number of boilers, Birkholz-Terbeck burners have been installed. By reason of the mixture obtainable with this equipment, the boilerhouse crew finds regulation easy and the combustion temperatures are maintained near the theoretical maximum. Boilers whose normal rating could never be reached formerly with blast furnace gas alone, are now operated without difficulty on loads 50 per cent above rating without the assistance of coal firing.

Of less commercial importance, but otherwise of no less moment, is the difference in the atmosphere around the blast furnaces since all of the gas is washed. While formerly much effort, labor and money had to be spent in the blast furnace department in order to keep abreast with the high standard of plant cleanliness, this handicap has now been entirely removed. With dust no longer issuing from stove and boiler stacks, or leaking out at stove and boiler burners, the blast furnaces compare most favorably with any other branch of the works and conditions for the workers have been made much more pleasant.

Washed gas is now extensively used around these furnaces for a variety of purposes, including the heating of rooms and buildings. This was quite impossible with dirty gas, owing to the stoppage of pipes and plugging of stoves. In suitably constructed stoves the washed gas burns very freely, and requires no attention. The replacement of a large number of radiators for heating purposes effects a considerable saving in steam, but the largest fuel saving in connection with the question of heating has come about through the abolition of the coke salamanders commonly used around furnace plants in the winter season. At South works these salamanders are fast being superseded by washed-gas stoves, a change that represents a large saving in the course of a season.

With all the advantages gained from thoroughly washing and drying the entire yield of blast furnace gas, yet the method used at this plant is an extremely simple one, and the cost is small, amounting to less than 1c. per 100,000 cu. ft. of gas washed. Certainly the results justify ranking this development among the most important steps in the advance of the blast furnace art.

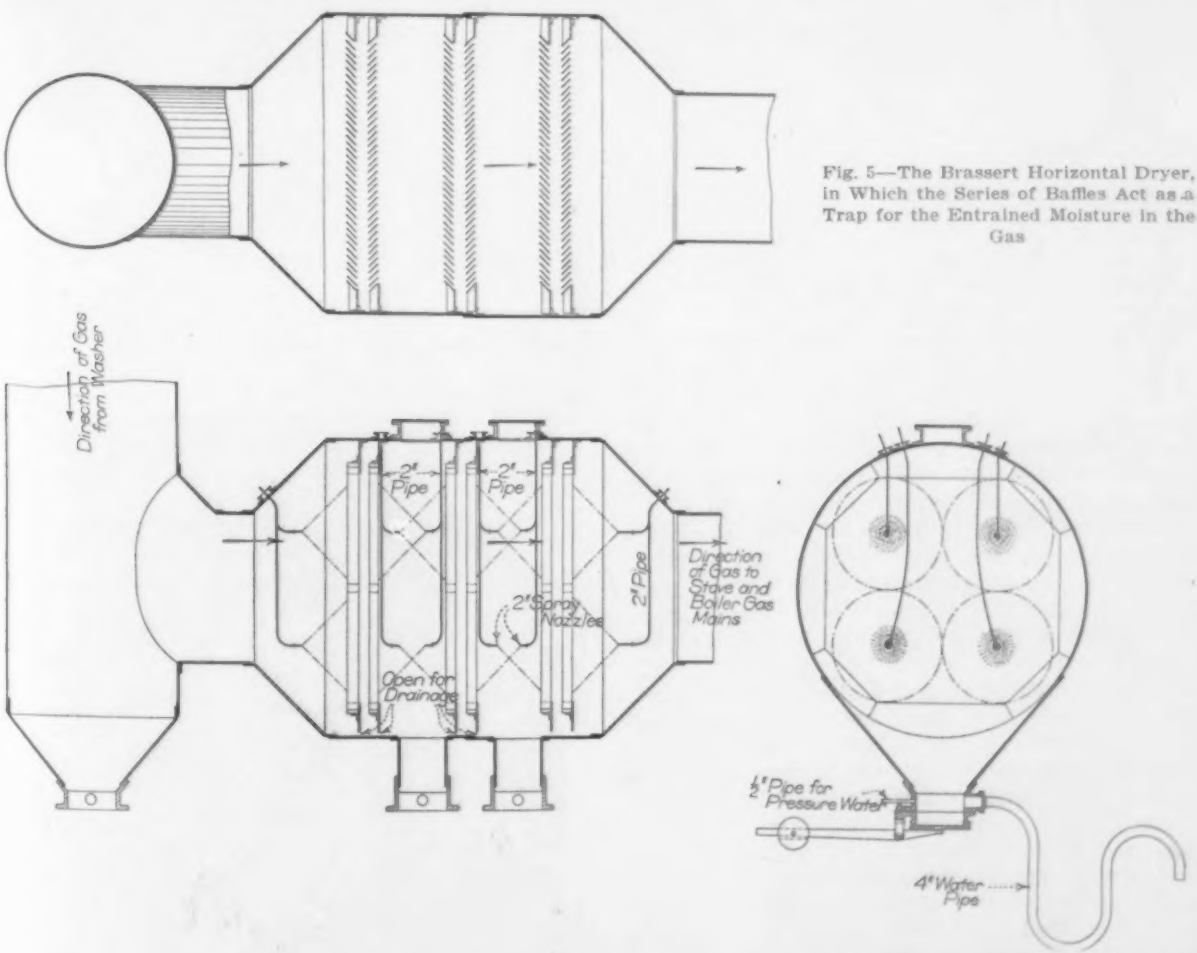


Fig. 5—The Brassert Horizontal Dryer, in Which the Series of Baffles Act as a Trap for the Entrained Moisture in the Gas

Plant of Pioneer Drop Forging Works

A Glimpse of the Arrangement and Equipment of the New Shops of the Billings & Spencer Company at Hartford

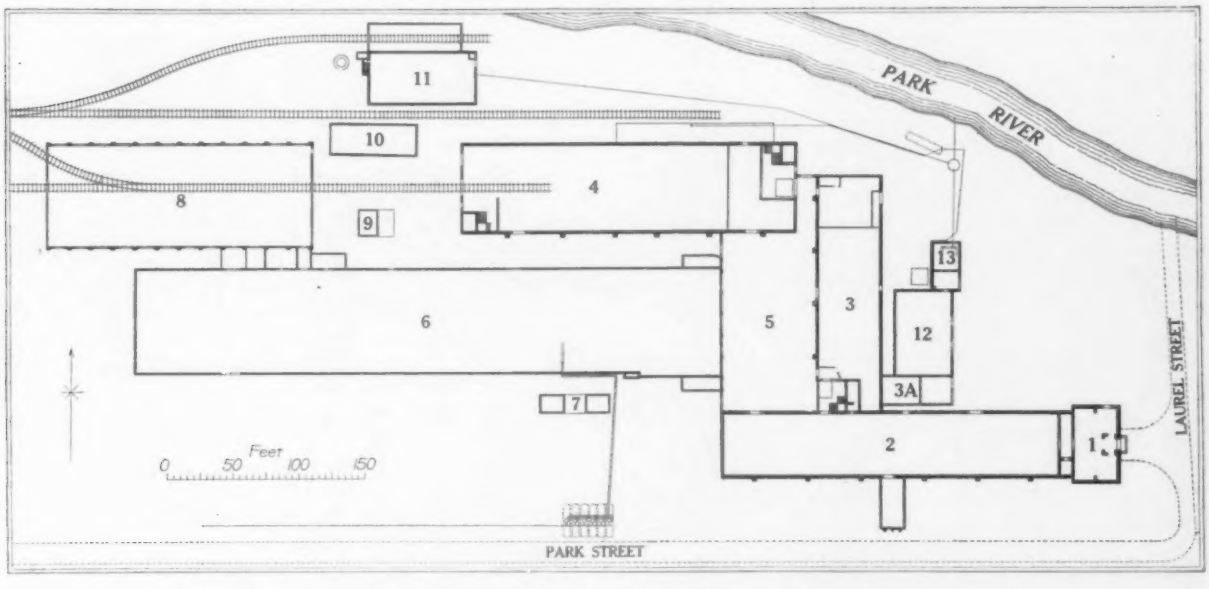
PROFITING from an experience of over forty years, the Billings & Spencer Company, the oldest commercial drop forging concern in America, has reconstructed and now occupies an extensive group of factory buildings in Hartford, Conn., which form a notable addition to New England's large industrial establishments. The new plant makes clear to the visitor that careful planning and a rare fund of experience have played an effective part in its arrangement and equipment.

It is not often that an existing plant lends itself to the manufacturing requirements of another industry without the need for extensive alterations in the main buildings. The Columbia Motor Vehicle Company formerly occupied the plant and it was only after careful study had shown that, by making several additions and, with one exception, minor alterations to the existing structures, it would make an adequate home for a rapidly expanding business. The Billings & Spencer Company bought the plant in the early part of 1915.

A new boiler plant and a steel shed have been built and a part of the original group of buildings has been practically rebuilt into a large forge shop to house the drop forging department. With these additions the plant as a whole has been arranged to provide for an uninterrupted flow of material from steel shed to shipping room. Almost without exception the manufacturing processes for the part machining or the complete finishing and assembling of forgings and small tools are arranged in loops that extend but do not break this uninterrupted flow.

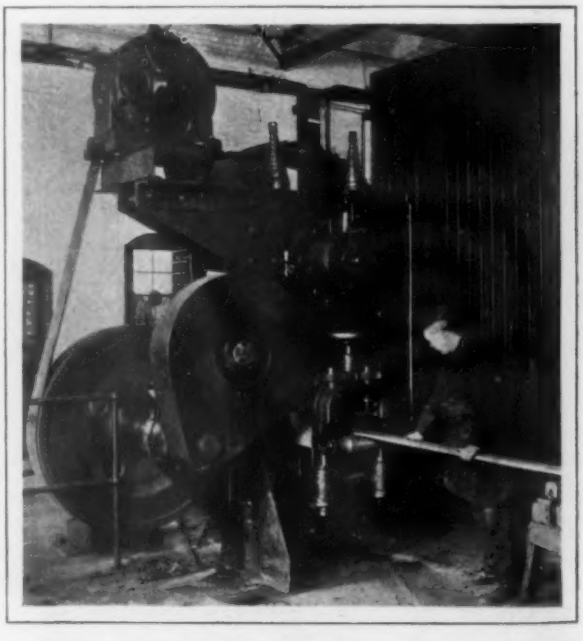
Several sidings are arranged so that raw materials can be unloaded directly from and outgoing shipments loaded directly into the cars. One of the illustrations shows a car on a siding that extends through the steel shed into the machine-erecting bay so that steel stock can be unloaded or heavy bases and other parts of the board drop hammers manufactured by the company can be loaded with ease.

The steel shed is a structure 81 x 201 ft., with a capacity for the storage of 5000 tons of steel. Cars are weighed on a track scale in the center of the shed and five cars can be unloaded under cover at



MAP OF THE WORKS OF THE BILLINGS & SPENCER COMPANY, HARTFORD

The buildings are occupied as follows: (1) office building, 3 stories; (2) die sinking, small tools, etc., 4 stories; (3) lockers, shop hospital, grinding, polishing, etc., 4 stories; (3A) die proofs, lacquering, 2 stories; (4) hammer manufacturing, etc., 4 stories; (5) trimming, electric welding, etc., 1 story; (6) drop forging, etc., 1 story; (7) transformers; (8) steel shed; (9) pickle house; (10) supplies; (11) boiler house; (12) garage; (13) pump house



Bar stock is brought from the racks by a Coburn trolley and after cutting on one of two Pels shears is carried to the hammers by electric trucks

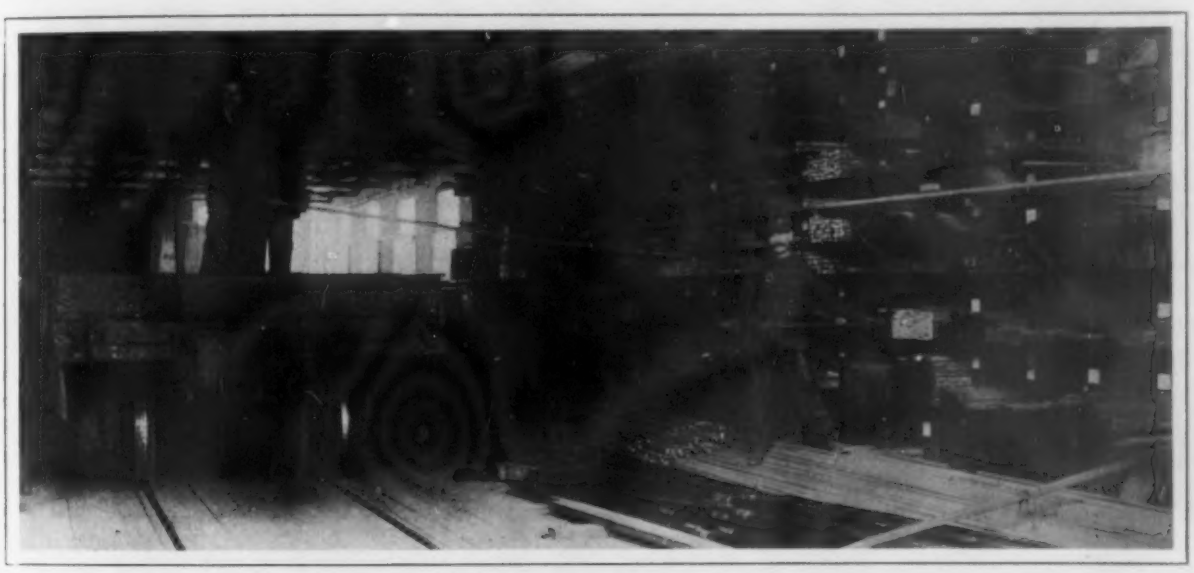
one time. Each lot of steel is kept separate and an analysis made of each lot. In the matter of analyses the Billings & Spencer Company is particularly well situated. The company formerly maintained its own laboratory, but in its new location it has as its next-door neighbor the Henry Souther Engineering Company.

The stock racks are made with uprights of heavy joists through which iron rods are run to support the bar stock. Each tier of the rack has twelve divisions, one 15-ton at the bottom, two 10-ton next and the others 5-ton. These weights are based upon the storage of bars 16 ft. long. A Coburn trolley track is being installed to convey the bar stock to the shears. The cutting-off equipment consists of two Pels shears of 4½ and 4-in. capacity, a Pratt & Whitney shear of 1¼-in. capacity, and two cold saws which will cut bars up to 8½ in. square.

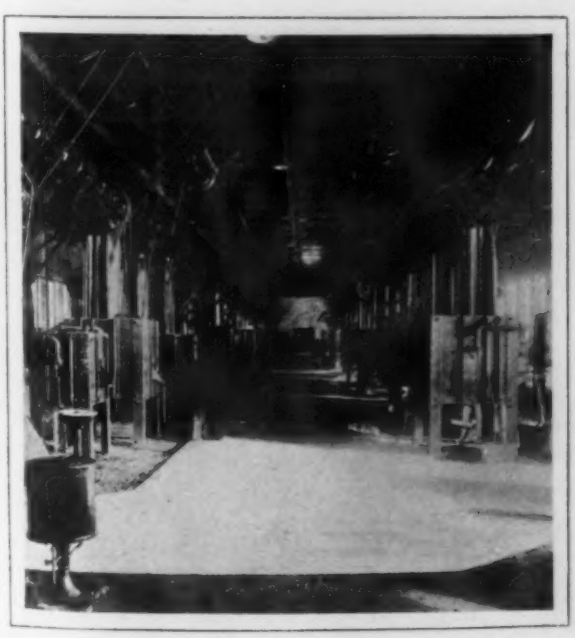
Electric trucks have been adopted to convey the cut stock to the hammers. As the chief product of the shop is commercial forgings weighing from ½ oz. to 215 lb. and a large number of hammers are in operation, the requisitions on the stock room are large in number, extremely diverse in character and usually call for comparatively small weights. In view of these facts it was decided that there would be less congestion and more flexibility with electric trucks than with a monorail or other type of conveyor. In passing from the shears to the forge shop, each truckload is weighed on platform scales which have their reading scales inside the foreman's office.

The forge shop is a building 80 x 446 ft., free from posts as the roof is self-supporting. It is 21 ft. to the under side of the chords and the roof has a 60-deg. pitch, rising to a monitor 20 ft. wide, which has Drouve shutters on each side. Each unit (one-quarter) of these shutters is operated by chains from the floor. Two concrete trenches with plank coverings afford easy access to the steam, water, oil and air pipe lines. Six oil storage tanks are buried under ground in the yard adjoining the forge shop and are so placed that they can be filled by gravity through a pipe line extending to a siding where the tank cars are spotted for unloading. The capacity of these tanks is 50,000 gal. of fuel oil. Three independent oil pumps circulate the oil through the forge and heat-treat shops.

The power used throughout the plant is electric,



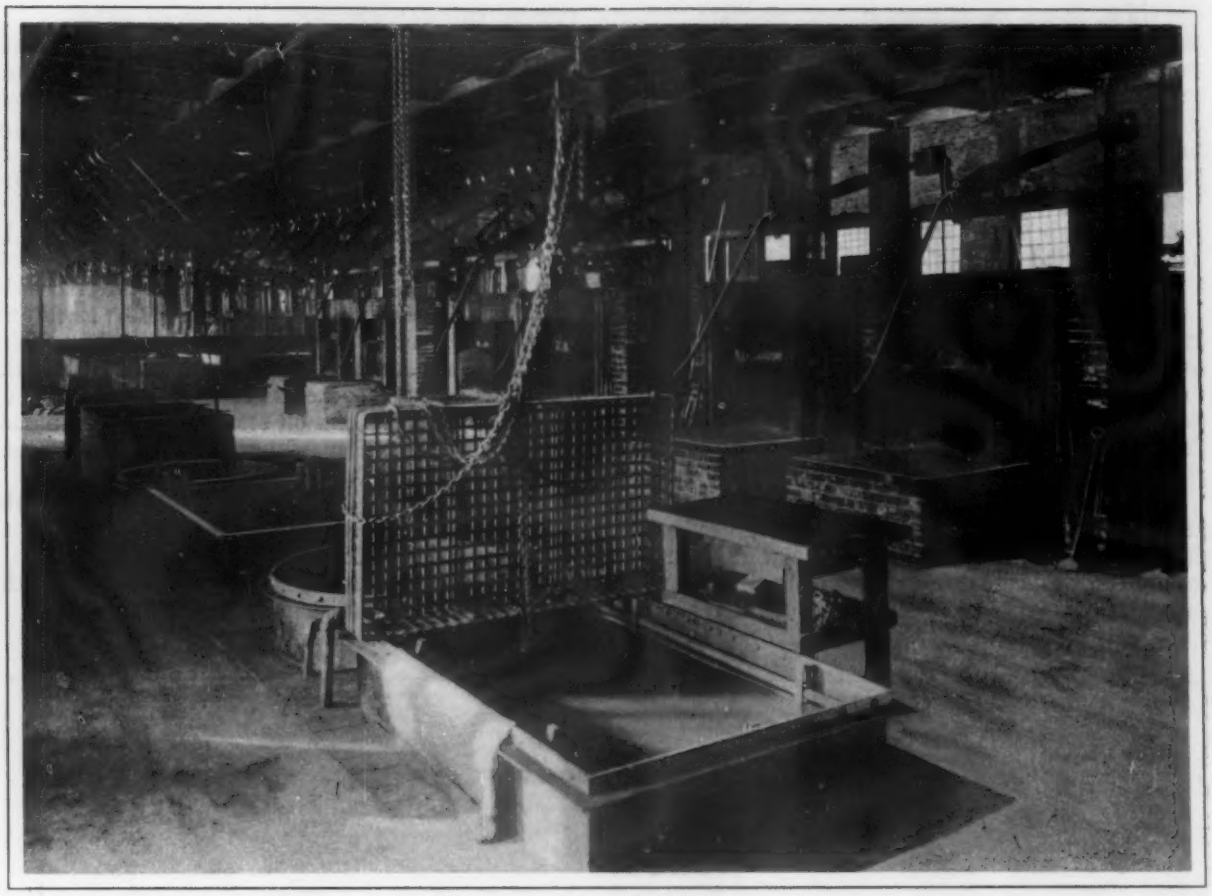
The steel shed is arranged so that cars can be run directly through the center and unloaded into racks on either side. Each tier of the racks is separated into twelve divisions; the bottom one of 15 tons capacity, the next two 10 tons and the others 5 tons. These weights are based on bars 16 ft. long.



The difficulty in lighting the full length of the central aisle of the board drop hammers prevents giving an idea of the length of the building, 446 ft.

which is purchased, and much attention has been given to the independence and duplication of motors and drives. This is particularly true in the drop forging department, which is the heart of the plant. The board drop hammers are driven by five motors, so that in case of trouble only one-fifth of the hammers will be affected. The blower system is so "tied" that any three of the four Sturtevant fans will furnish air for the entire forge shop. There are two fan units at each end of the shop, furnishing air for the forges at a pressure of 12 oz. The equipment of the shop comprises board drop hammers of 400 to 2200-lb. rating, 1500 to 7000-lb. steam hammers, heading machines and bulldozing machines up to 5 in. capacity, hydraulic presses up to 1200 tons capacity, Bradley helve hammers and the other apparatus necessary in a fully equipped forging plant. Rockwell forges are conveniently placed so that there may be no lost time or lost motion, ranging from a single furnace beside the smaller hammers to three or four furnaces alongside the large steam hammers.

The steam hammers, headers and hydraulic presses are placed at the far end of the shop. Next come four long rows of board drop hammers. Passing through the central aisle of these toward the



The six furnaces shown were built by the engineering staff of the Billings & Spencer Company. The oil from the oil tank is constantly circulated through coils in the water tank to cool the oil

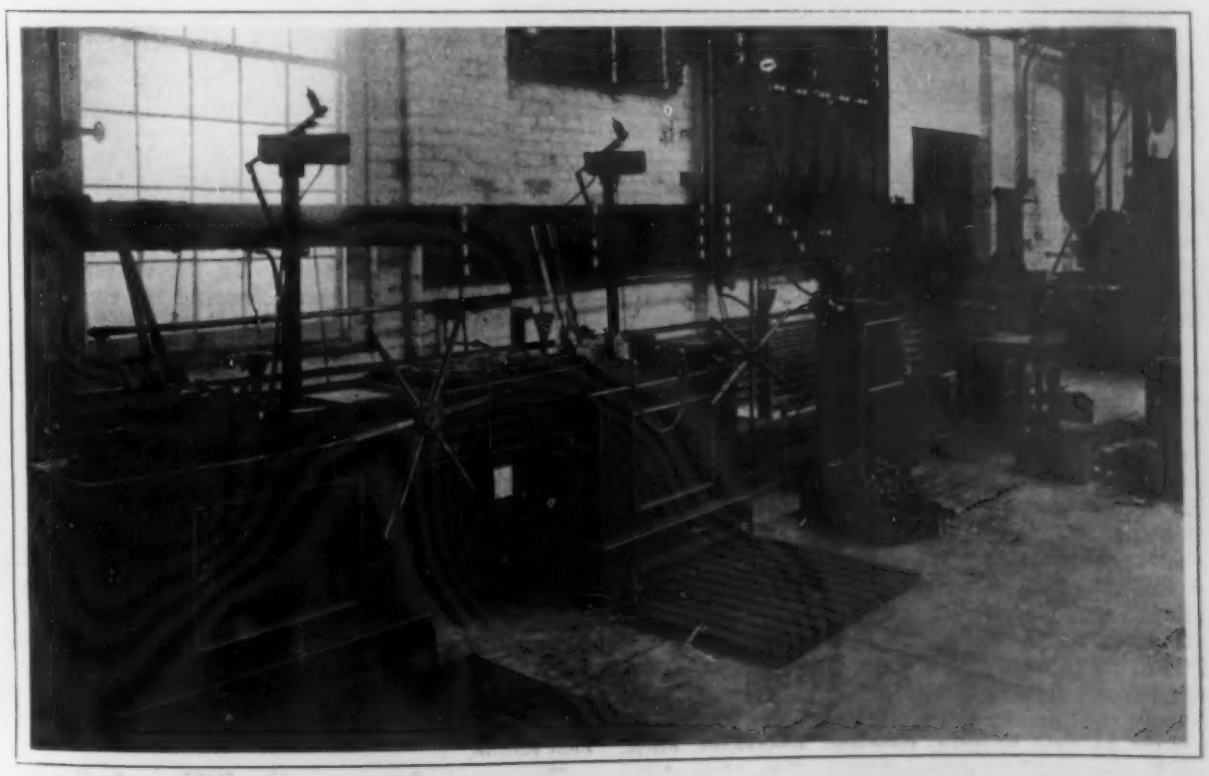
trimming department, one comes to the hand-forging department on the left and the heat-treating department on the right. The heat-treating department is placed here for convenience, forming one of the loops in the line of orderly progress before mentioned. Besides an equipment of standard furnaces of varying sizes and types, it contains six larger furnaces built by the company's engineering staff, which are shown in one of the illustrations. This view also shows the installation of oil-tempering and water-cooling baths. Two small motor-driven pumps keep the oil circulating in coils in the water tanks to cool it. The heat-treating department has a complete equipment for oil or water treatment, annealing, case-hardening and tempering of all kinds. The furnaces are equipped with

The greater portion of the forgings are of comparatively small size and the cleaning is done in six New Haven shot blast machines. The larger forgings are pickled and a new pickling house is now in the process of construction

This view shows the well arranged and well lighted trimming room and gives an idea of the number of trimming presses in use and the power transmission system

pyrometers connected with Esterline recording and Bristol portable recording thermometers installed in the department office.

The trimming department is housed on the bottom floor of the next building in a room measuring 78 x 134 ft. The pitched roof rises to a monitor similar to the one in the forge shop and has two rows of additional skylights lower down near the side walls. Two long rows of Ferracute and Niagara presses extend down the center of the room, affording ample space for trucks and piles of trimmings. Along the side of this room are placed six New Haven shot-blast machines and a battery of Toledo electric welders. The electric welding machines have a



As the company does a considerable amount of forging work for automobile and other machine manufacturers this battery of Toledo electric welding machines provides for furnishing eye bolts, rod and yoke ends and other special work

capacity up to 1¼ in. round and enable the company to furnish eye bolts, rod and yoke ends and special work of any length desired. In another corner of the room are placed three air compressors which furnish air for the shot-blast machines, the die-sinking department, the drop-forge shop and all other parts of the plant where compressed air is used. Any two of these compressors will furnish sufficient air for the whole shop and any compressor can be used on any job.

A new pickling house is in process of construction adjoining the forge shop.

Commercial forgings which are not to be further machined pass directly from the trimming department, after inspection, to the shipping room, which adjoins it. After boxing or other packing, the forgings are loaded directly into cars or express trucks. Platform scales with dial readings are so placed that all outgoing shipments pass over them and the weight is quickly recorded. Goods from the unfinished or finished stock rooms reach the shipping room by elevator, directly from the packing departments of the stock warehouse.

The die-sinking department occupies the ground floor of the building immediately adjoining the trimming shop. As has been stated, commercial forgings form a large part of the product of the company, and so both the equipment for die making and the racks for die storage are extensive. In this department is found the usual equipment of planers, shapers, die sinkers and other machinery. A die-milling machine which the company has developed and manufactures for the trade here and abroad is an interesting machine and has a large field of usefulness, especially in the making of trimming dies. The next two floors above the die sinkers are occupied by the small tool department, with groups of drill presses, profilers, broachers, automatic screw and turret machines. A portion of the third floor is devoted to the assembling department where the small tools made by the Billings & Spencer Company assume their finished form. A portion of the fourth floor is utilized for the storage of finished parts and by the strawboard box or carton department.

Swinging around another turn of the loop, brings one into a building adjoining both the trimming shop and the building just described. The ground floor is used mostly as a locker and wash room, in which are installed the steel lockers and good toilet facilities which have become recognized as an essential part of every modern industrial works. The rear portion of this floor is used for the storage of supplies, the employment department, and the shop hospital, which is equipped to take care of all but the most severe injuries and to render first aid in any case of illness or accident. Here, too, is a fire-proof room for the storage of models and die proofs.

A part of the die sinking department

On the floor above is located the rough grinding and polishing departments. In the center of the room is the plating department and the removal of dust from the grinding and polishing machines is so thorough that no trouble from dust, either in the plating or lacquering departments, is experienced. The lacquer department, which is in a small separate building, opens directly from the polishing room. The problem of lacquering steel has reached a high degree of perfection in this plant as a result of years of experiment and original research.

The third floor contains hundreds of bins for the storage of unfinished forgings which are furnished in increasingly large quantities to customers who machine and finish them to meet their own particular requirements. The top floor is devoted to the finished small tools and wrenches which have always been a substantial part of the company's business and for which it is best known to the general public.

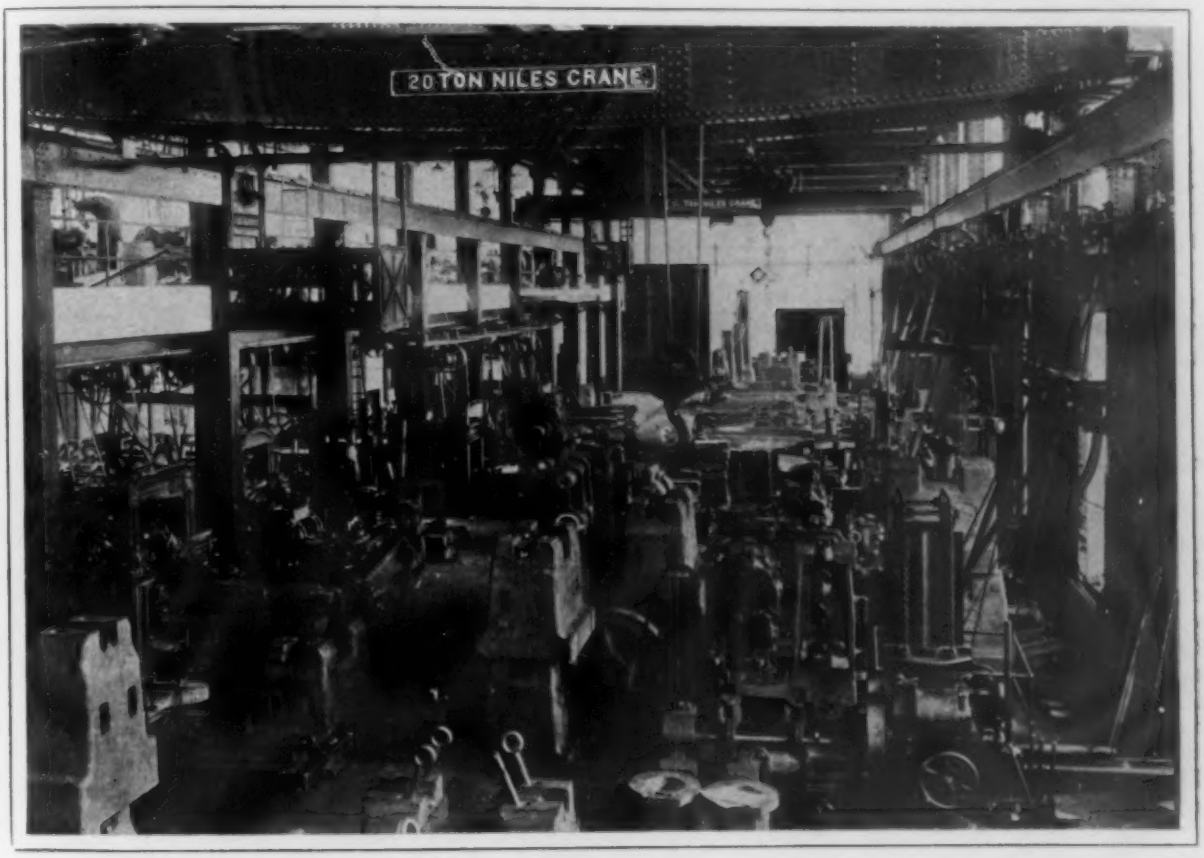
For twenty-five years the Billings & Spencer Company has built drop forging hammers of the

board type. The machine shop for the building of hammers is located in the building shown as No. 4 in the general plan of the works. This building has been remodeled to provide the large erecting bay shown in one of the illustrations. Much massive machinery is installed to shape the bases and other heavy parts and the handling of these heavy pieces is provided for by two Niles traveling cranes, one of 20-tons capacity and the other of 7½-tons capacity. In order to provide the necessary height for the erecting bay, the second floor has been changed into a balcony and here some of the lighter machinery is installed. Two sections of the balcony are given over to the plumbing and piping department and the belting and oiling departments. Two rooms on the third floor are used by the painting and the electrical departments and the remainder,

The steam-heating mains are carried to the top floor of each building and drops are run down to each coil. The boiler room is so much lower than the other buildings that a vacuum system can be installed without a pump. The lighting throughout the plant is by 100 to 500-watt nitrogen lamps with Wheeler reflectors.

All of the old office building and a part of the No. 2 building are given over to offices and engineering departments. The accounting and purchasing departments are on the first floor. The executive offices and the cost, sales and production order offices occupy the next floor, and the drafting room and experimental department the floor above.

The Billings & Spencer Company is a direct descendant of the Roper Sporting Arms Company, which carried on a manufacturing business in



Erecting the board hammer machines

now being used for storage, is left vacant to allow for further expansion of the plant. The fourth floor is used by the pattern and carpenter shop.

The boiler plant is in a new building measuring 41 x 83 ft., and the coal pocket adjoins this building on the side facing the boiler heads. Coal is dumped from the cars into the coal pocket and flows by gravity to openings in close proximity to the fire doors, so that it is not necessary to wheel in and pile coal on the boiler room floor. Four 250-hp. Ames tubular boilers are now in place and room is provided for two more. A new concrete stack has been built, 7 ft. in diameter and 150 ft. high, giving a capacity for the installation of boilers of 1500-hp. rating.

A fire pump house is equipped with a motor-driven fire pump so that it is not necessary to keep up steam at all times to insure proper fire protection. River water is used for all but drinking and washing purposes. A cofferdam has been built in the Park River, which runs on one side of the site, and two Norwood filters are provided, capable of cleansing 100 gal. of water per minute.

Amherst, Mass., in Civil War days. Some time before 1868 C. E. Billings and C. M. Spencer became associated with the Roper company and in that year the business was moved to Hartford, Conn., to the site just vacated. In 1872, the Billings & Spencer Company was chartered and took over the Roper plant and business. This became the first commercial drop forging company and made largely gun and pistol parts and shuttles for sewing machines. In view of conditions abroad at this time it is interesting to note that its first extensive contract was for the manufacture of the dies furnished by the Pratt & Whitney Company as part of a general contract for the equipment of arsenals in Germany. In 1890 the manufacture of drop hammers was taken up. Since that time the concern has experienced a period of gradual and steady growth and physical expansion until the new plant became a necessity. C. E. Billings, one of the founders, is the president of the company and active in its counsels, living to see the ideals cherished through a long and busy lifetime find fruition in this latest achievement of this old New England industry.

Lessons of Europe's Scramble for Munitions

Widespread Information for Our Manufacturers and Not Secrecy—Government Gages and Other Aids Should Be Planned

BY STERLING H. BUNNELL

S. H. BUNNELL

THROUGH no acts of our own we of the United States are to-day confronted with the problem of adequate defense of our national rights as a peace-loving people. Since war between civilized nations is no longer, as it was only a short time ago, seemingly impossible, we are forced to meet the issue squarely, and decide upon ways and means of carrying out our established policy of defense—never aggression — by a volunteer army of citizens, normally engaged in their own peaceful pursuits, but ready and fit for duty as trained soldiers if ever the need for their services should arise.

MUNITIONS A GREATER NEED THAN MEN

In any scheme of national defense, men form only part of the resources which must be brought into use. It has been shown in the present war that the larger supply of munitions and equipment defeats the superior number of men; the army cut off from its munitions factories disappears as an army, though most of the soldiers may have escaped death or capture; and nations desperately fighting for existence are forced to mark time while factories and shops can be located for the supply of their armies. Evidently, in a war with a strong enemy, all the powers of a nation must be employed and pushed to the limit of their capacity; shipyards must build more ships; clothing and shoe factories must provide for the heavy wear of army service; and every machine plant must turn out the greatest possible quantity of the mechanical devices which are absolutely necessary for the life and work of modern armies.

As war is the last thing to be desired as a national occupation, it would be the height of foolishness to provide enormous government factories for supplying on an adequate war footing a large army of defense, which we hope fervently will never be called upon to fight. Such plants would tie up an enormous amount of capital, and deteriorate in partial idleness in time of peace. Government plants of moderate size have their proper place in the plan of national defense; but the workshops of private citizens must be the main dependence for the supply of the citizen army, if it is ever called upon to take the field. The manufacturing problems which have been put up to American factories engaged in the production of munitions for the various European countries now at war are the same as will be offered in the event that the United States is to be defended against military attack. The experience of those who have undertaken such work is therefore of interest to all American shops.

Speed in the first production of military supplies is vitally important. Yet, following the outbreak of the present European war, months passed in mere negotiations for the purchase of supplies, before the actual contracts were signed. The production in the United States of army rifles, machine guns, heavy guns and ammunition of all kinds was at that time in the hands of a half dozen large corporations, and the products of these were naturally sold immediately to the limit of their output for months to come. Though the few existing sources of supply were thus promptly taken up, and it was well known that there were no others, the foreign purchasers seemed to fail to grasp the situation, and refused to consider anything but contracts for immediate delivery of enormous quantities of their standard munitions, which, of course, nobody could possibly provide. Several valuable months were lost in this way, before the plans were changed so as to permit the construction and equipment of factories for future deliveries.

HOW NOT TO BUY MUNITIONS

The most effective hindrance to the supply of munitions in America has been the studied concealment of the authorized purchasing commissioners of foreign nations. When large purchases are to be made, it is the habit in this country to let the fact be publicly known, together with the address of the purchasing office. The manufacturers interested then send competent salesmen to ascertain the requirements and quote prices and terms, and the business is promptly concluded. No non-technical broker or middleman would think of appearing in such a transaction, still less of standing between purchaser and seller and collecting a commission for a mere introduction. It is still a mystery among the manufacturing interests of this country, that the purchasing governments have deliberately chosen to conceal their authorized agents from the real manufacturers, and reveal them only to the horde of irresponsible commission men whose only offices are in many cases the public seats in the corridors of metropolitan hotels.

In the event of the rapid armament of the United States, direct methods of negotiation of contracts would undoubtedly be adopted. Serious delays would still result, however, unless a radical departure is made from the usual forms of government specification, which are made for the purpose of discouraging general competition, and limiting bids to the few manufacturers already experienced and competent. This method is entirely proper as long as there is a surplus of satisfactory goods offered, but highly inadequate to the situation when the regular manufacturers are unable to produce the amounts required. The specifications for war material should therefore be accompanied by a manual giving a full description of the methods of manufacture which are preferred, the particular points where special care is required, and the rate at which the work can be turned out by trained men. All these matters must be found out by manufacturers; and will be found out in spite of all precautions, by foreign secret services. There is no possible reason for restricting the knowledge to a favored few, and every reason for informing

every manufacturer whose equipment is suitable for use in such work in time of need.

MODEL GOVERNMENT TRAINING SHOPS

The work of developing sources of war supplies can be greatly helped by establishing model shops of moderate size, operated by the Government, and located in convenient centers throughout the country—not by any means all in one district near the coast in easy reach of attacks by sea, as the greatest of such American shops are now placed. These Government shops need not be large, because the full military defensive power of the country is in utilizing the whole number of its citizens and all of their factories and machinery, and is not limited to the capacity of national munition factories alone, however large these might be. Information and instruction should be freely furnished to accredited men from private shops available for similar work.

GOVERNMENT SHOULD CARRY STOCK OF GAGES

Large numbers of standard gages and indicators for testing and maintaining the accuracy of work should be ready in the Government toolrooms, for loan to manufacturers doing contract work. The total absence of all these has caused the loss of one to three months in commencing deliveries on every shell contract placed in this country. In the European shell contracts, each contractor has been required to make his own sets of the forty or more gages needed for each size of shell. The working limits on projectiles are extremely close, so that the gages can only be made by a tool-making department, equipped with standard measuring bars, micrometers, precision grinding machines, and all the apparatus of refinements in measurement that is found only in about a half dozen shops in the United States. The repeated construction of single sets of gages and measuring instruments for the same size of shells has caused great unnecessary expense and loss of time, and increased the work of the inspectors who have had to check up each new outfit separately. These delays can be avoided in the American plans for preparedness by providing a supply of gages and instruments sufficient to equip every shop instantly upon need.

These are only a few hints toward the efficient use of our manufacturing plants in time of war. Undoubtedly United States military and naval attaches who have served in Germany, which was prepared for war, could contribute many excellent suggestions toward greater efficiency in turning the powers of all to the best account. Probably our attaches in the countries which were not prepared could add some hints as to practices which should be avoided or improved. We must already possess all the facts, if we will only study and profit by them.

ENORMOUS GOVERNMENT PLANTS DECIDEDLY UNWISE

It is greatly to be hoped that common sense instead of common politics will rule in working out the plan for national defense. Employment for every man is the greatest blessing, in peace or in war. A call to the defense of the nation must necessarily upset trade conditions, causing many factories to stop work. The workers and machines in these factories ought to be put on the manufacture of munitions at once, or substituted for other workers who go into the fighting line. Millions of men and machines may thus be counted into the defensive powers of the country. There is not a grain of sense in the proposition brought forward by a small minority of Congressmen, to provide enormous Government plants adequate to arm and maintain the entire national defense forces. Such plants would add greatly to the military establishment of the country, and increase the line of division between a body of citizens growing more careless and unpatriotic each year, and the professional fighting force hired to keep them safe in their indifference to their country's honor. By all means, let us have a plan which will make it every man's personal interest and duty to do his part himself in the national defense, whenever his country may call him.

Making the 6-In. British High-Explosive Shells

Routine for Producing One Hundred 6-In. 100-Lb. Shells per Hour from Forgings—Proper Varnishing and Marking

STEEL used in making British high explosive shells from forgings may be open-hearth, either basic or acid. Bessemer steel is barred except under specific conditions subject to agreement. One requirement is that only "non-phosphoric" pig iron shall be used as the raw material. Both phosphorus and sulphur must be kept low—not more than 0.05 per cent, while the maximum carbon, silicon and manganese contents are specified as 0.55, 0.30 and 1.00 per cent, respectively. No additional hardening or toughening elements, such as chromium, are allowed to enter into the steel without a definite understanding on that point with an authorized representative of the British Ministry of Munitions, except for nickel and copper. Of the former 0.50 per cent is considered desirable, with 0.10 per cent copper.

ELIMINATING PIPING IN THE INGOT

Ingots from which the bars are rolled are preferably top-poured, and it is the understanding in England that at least 20 per cent will be cut from the top of the ingot, together with enough more, if necessary, to completely insure the elimination of piping. For the use of bottom-poured ingots, as produced in England, special permission is required, and the crops from both top and bottom will total 25 per cent or more, the exact division being left to the discretion of the British inspector.

One of the latest specifications issuing from the Woolwich arsenal says on this point:

"The portion to be cut off is to be removed by sawing and breaking down after the ingot, or partially forged ingot, has cooled; and such parting, in the case of a partial forging of an ingot, should be effected through a section of the ingot which has not been forged. Contractors who have not the necessary plant for cutting the discard from the ingot cold will be allowed to roll or forge the ingot to billet size before the removal of the discard. The area of the fractured part will be one-twelfth of the sectional area of the ingot."

After a section of billet or bar has been pierced, drawn and formed, practically as described in THE IRON AGE, Sept. 2, for shrapnel, except with the

use of heavier presses, the shell blank is trimmed to slightly under 19 in. in length and then roughed off at the base, a boss 0.6 in. x 1 in. being left. Cut-off and facing machines of simple type, capable of handling 6-in. stock, are all that these operations require; and four of each, or six combination machines, will suffice. The machining, which in all cases will be understood to include handling, takes about three minutes.

Roughing the cylindrical section of the shell body, over a uniform diameter of 6.2 in. and a length of not to exceed 12.52 in. from the base, will naturally be done in a lathe, and a production of five to six shells per hour can be maintained for each machine; so that twelve lathes will do the work and still leave a spare.

Machining of the nose, over a length of 6.3 in. and a diameter tapering from 6.2 in. to 4.2 in. for the roughing cut, is accomplished on a separate battery of lathes, ten to twelve of which will be needed. The radius of the head is two calibers, or 11.92 in., 5.96 in. being the finished diameter on which the shell is designed. This head is required to be "concentric with the true longitudinal axis of the body within a limit of 0.0375 in. as a maximum," which shows the nicety of the machining and gaging essential to work that will pass inspection.

MACHINING OPERATIONS OF THE SHELL INTERIOR

Complete machining of the shell interior, both roughing and finish cuts, can be done to advantage on lathes. With one set of machines built especially for shell work the outline of operations is as follows:

1. Bore inside cylindrical surface to a diameter of 3.58 in. with tools secured in a special bar and holder.
2. Bore lower tapered section, which contracts from 3.58 in. to 2.7 in., with 0.8 in. bottom radius, and face bottoms, including radius curve, with forming tool, using the same bar and holder.
3. Ream inside of shell to 1.14 in. maximum wall thickness and to between 3.62 and 3.64 in. cylindrical diameter, with corresponding dimensions for the bottom-tapered section based on 1.82 in. radius.
4. Face nose end, which has a finished peripheral diameter not exceeding 2.412 in. and 0.41 thickness of metal, using a tool held in the front tool post.
5. Bore inside diameter of nose to a maximum of 1.1912 in., with cutter held in tail stock.
6. Mill thread with cutter held in front tool post.
7. Chamfer for thread.
8. Finish tap.

The bottom of the thread is on a maximum diameter of 2.003 in. A right-hand thread, 14 to the inch, is used. The "tommy" hole for the fixing screw, which is made from ½-in. stock, 20 right-hand threads per in., is drilled and tapped later in a special machine.

THE NOSE BUSH

Some specifications for 6-in. shells provide for a nose bush, indicated as an optional arrangement in the general working drawing, Fig. 1; but, if the contract permits, it may be omitted and the fuse socket formed in the nose of the shell. When called for, the nose bush is required to be made of mild steel or brass and provided with a tommy hole and fixing screw, ½ in. in diameter, the hole being drilled and tapped as in the case of the fixing screw first mentioned. The threading of the nose bush is the same as that of the nose, and the mating between the bush and the throat formed to receive it must be sufficiently accurate to make the bush a good fit but easily removable. After being inserted, the bush is slightly unscrewed, to facilitate taking it out for inspection upon delivery.

Machining the interior of the shell head for this bush practically duplicates in method several of the boring and threading operations given above, as will be readily seen by reference to the drawing; while omitting the bush calls for forming a conical chamber, truncated, in the wall of the shell head for an axis length of 1.4 in. on 1.75 in. radius. Where the bush is used, roughness and sharp edges must be absolutely eliminated from the shell chambers at the junction of the body with the nose bush.

Summarizing the work on the interior of the shell, as above outlined, it is difficult to say just how many and what machines are required to perform it, without also considering the conditions prevailing in the shop where they are to be used. If it is all done on one set of lathes, with the fuse socket formed directly in the nose, a production of four shells per hour for each machine is the maximum under ordinary circumstances, thus taking at least twenty-five lathes, with special attachments and holders. Cutting and threading a throat to receive a nose bush, when specified, will mean five to eight additional lathes.

If, on the other hand, single purpose equipment, including drills, lathes, recessing and threading machines, is used, the units will be considerably increased, as outlined in the article printed in THE IRON AGE, Dec. 2. A nose bush, which was not considered in that article, also means further equipment.

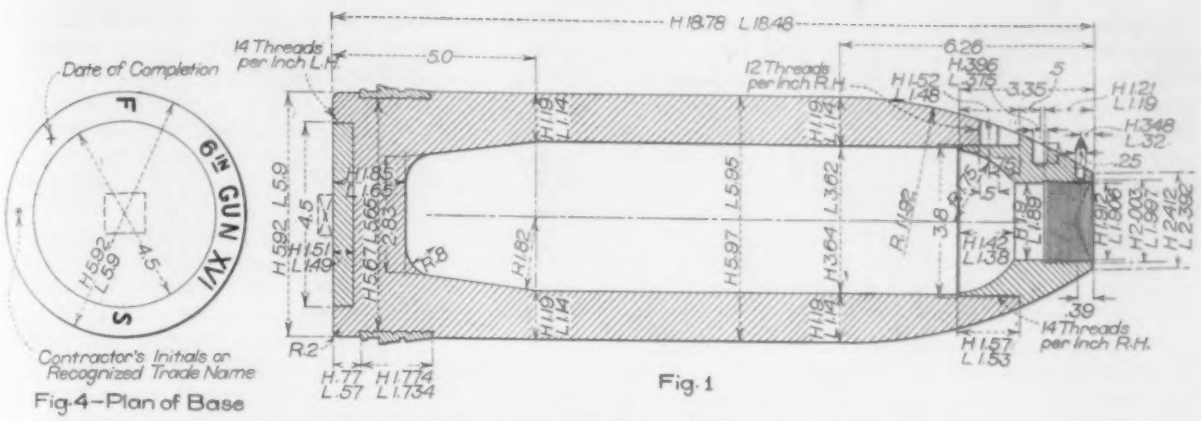
With the above in mind, and leaving the manufacture of the nose bush for later consideration, we may pass to the finishing operations on the shell exterior.

THE OUTSIDE FINISHING OPERATIONS

After insertion of a plug in the open end for centering, the shell is chucked in a lathe and the band seat cut to a maximum width of 1.774 in., both roughing and finishing cuts being taken. Two tool posts are used. The double operation can be performed so as to give a production of about twelve shells per hour for each lathe, making not over ten machines necessary, with a spare included.

Next the groove is undercut and waved, with the number and spacing of ribs shown by Fig. 2. This operation requires a lathe with some form of special waving attachment, such as has already been described in previous articles. The complete operation takes less than three minutes, so that five machines are ample. Chisel cuts are made by hand across the waves in the groove at an angle to the longitudinal axis of the shell to allow the air in the channels between the waved ribs to escape when the band is pressed on. By means of a turret tool post, together with the waving attachment, all of the band seat operations can be performed on one set of machines, thus reducing the total number of working units.

Recessing the base 0.49 to 0.51 in. and cutting or milling the threads for the base plate can be economically done either on a lathe or on a special purpose machine. Twelve to fifteen complete operations per hour are possible, making eight machines ample for the purpose. A point is made in specifications of the fact that the bottom of the recess, which should be "quite flat and turned smooth" and exactly 4.5 in. in diameter, must fit snugly against the base plate. The screw threads in the walls of


Date of Completion
6 IN GUN XVI
Contractor's Initials or Recognized Trade Name
Fig.4—Plan of Base
14 Threads per Inch L.H.
12 Threads per Inch R.H.
14 Threads per Inch R.H.
Fig.1

PLAN OF BASE AND SECTION OF A 6-IN. SHELL

The steel base plate or disk, which is screwed home, is coated with Pettman cement and riveted

the recess, 14 to the inch left-hand, are required to be of the British standard fine screw thread. In forming the bottom of the shell chamber and afterward recessing for the base plate, the minimum thickness of metal left intact in the base is 1.14 in., and it may be 0.20 in. more.

The base plate, after being turned out on a special automatic machine, with smooth under side and threads to mate with the threads in the recess, is coated with Pettman cement, fitted in place and riveted. The bottom of the shell is then smooth-faced across the base plate and 0.2 in. radius chamfered around the edge. Five special facing machines are sufficient, as this operation can be done in three minutes.

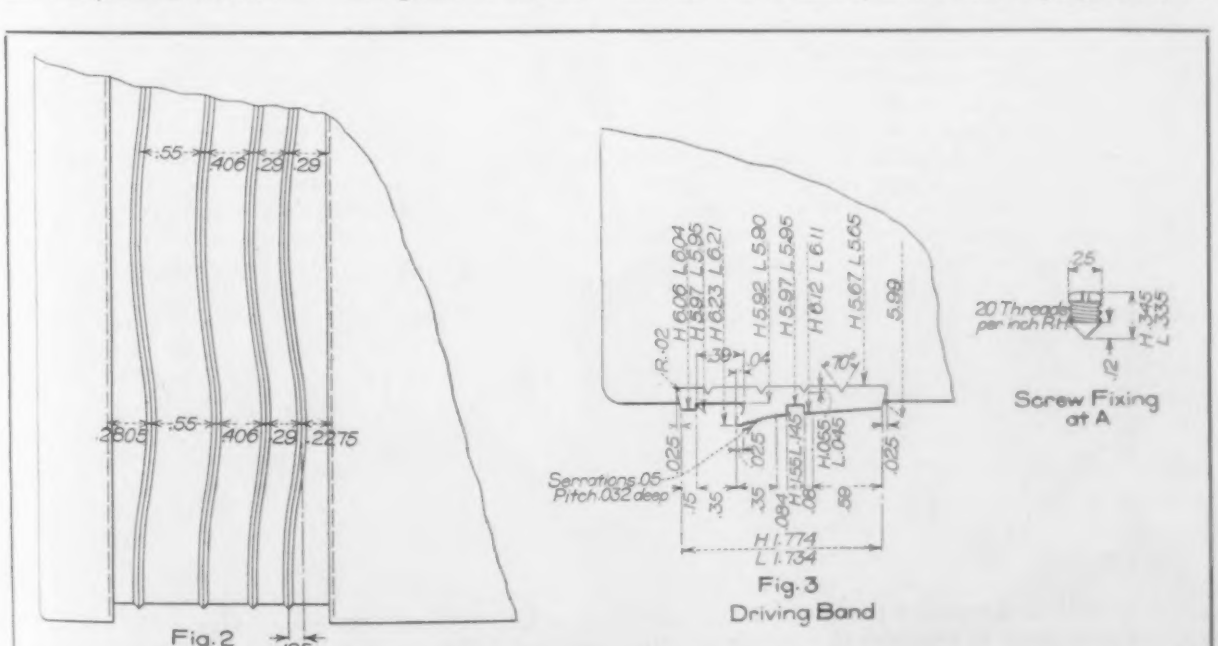
THE PRELIMINARY INSPECTION

Before the shells are banded, they must be submitted for preliminary examination, and this may take place before the base plate is screwed in and the base finished. The base plates are required to be submitted separately, when machined and ready for insertion. They may have a camber of not exceeding 0.002 in. to insure perfect contact with the bottom of the recess. The steel used for these plates must be of the best quality and "free from lamination, flaws, cracks, surface or other defects and uniform in structure." The grain of the material lies at right angles to the axis of the shell when in place.

Two test pieces are taken from the finished base plate at right angles to each other and must both be capable of standing tests as follows: Tensile strength, 70,000 to 98,000 lb.; elastic limit, 38,000 lb.; elongation in two inches, 12 per cent. It may also be remarked here that the requirements for the steel forming the body of the shell are the same, except as to 17 per cent elongation. For cutting and shaping the necessary test pieces a saw, drill, slotter and miller, all light tools, are commonly used.

The band is sliced from copper tubing, in a cut-off machine, especially adapted. The material is drawn copper which must not contain more than 0.004 per cent bismuth and 0.01 per cent antimony. It is pressed on, by means of the usual hydraulic or compressed air press, into and in contact with the waved bottom and undercuts of the groove forming the band seat of the shell. One cutting machine and two or three presses, with heating furnace to bring the band to the proper temperature suffice for this operation. The band, when heated, is of a size to just pass over the base of the shell and into the groove.

After banding, the shell is placed in one of another set of lathes, fitted with a plug center in



DETAILS OF THE WAVING AND CONTOUR FOR THE RIFLING BANDS

The part development of the shell, Fig. 2, shows the waved ribs, which are given six waves. Three chisel cuts may be made across the waved ribs

the open end and a false cup center at the closed end, and the turning of the band, as shown in detail by Fig. 3, is roughed and finished, multiple tool posts being used. Small grooves in the copper band are also turned and undercut. The entire set of operations takes somewhat under five minutes; so that not more than eight lathes are required. A variation in practice is to divide the operations between two batteries of lathes, but the net time will come out about the same.

SECOND INSPECTION FOLLOWING BANDING

Another inspection takes place after banding. The driving band may then, at the discretion of the inspector, be cut off one or more shells selected from the lot. Should this band appear not to have been thoroughly pressed into the groove and the undercuts throughout, or should it fail to comply with the above named requirements as to purity, the entire lot will be rejected. It will also be tested by being doubled and hammered flat upon itself. Should it crack or break under this test, the entire lot will be turned back to the manufacturer for that cause also. If he wishes to resubmit a lot of shells rejected because of a driving band test, he must remove all of the bands and press on and machine others before putting the shells up again for inspection. Few shells, however, fail to pass muster because of defects in the driving band, although there was a great deal of trouble with this when munitions contracts were first taken in the United States and Canada.

For the manufacture of nose bushes and also fuse bodies, if made in the same plant with the shell bodies, automatic multi-spindle chucking machines are the most economical. What was said on this point in the article on standardizing shell-making, printed in THE IRON AGE, Dec. 2, applies to both products. Six machines should suffice and less can probably be gotten along with.

VARNISHING AN IMPORTANT MATTER

When the shell bodies have been fully machined, and the nose bushes screwed in (if any), they must be coated internally with copal varnish, made from pure gum. During this process the threads are protected by inserting false lining over them. The shells are then placed on racks and run into a furnace for baking, being subjected to a heat of 300 deg. Fahr. for eight hours, if the specifications are strictly followed. Inspectors in general are inclined to be very particular about the matter of varnish. It is submitted to them before use and must be free from metallic impurity in any form, except for manganese, lead and copper not exceeding 0.50, 0.05 and 0.10 per cent, respectively. The results of the first analysis are checked by another made for each lot of shells by scrapings taken from them, and all shells used for such tests have to be revarnished at the manufacturer's own expense. It is also very positively affirmed in all specifications under which shells are now being produced for the British War Department that "This varnish must adhere firmly and present a perfectly smooth, clean and dry surface, free from cracks, flaws, impurities and other imperfections. Any shell having the steel surface under the varnish not clean and free from rust, scale and foreign matter, or in which the varnish does not adhere firmly, will be rejected."

This matter of varnishing is among the most troublesome of any connected with the manufacture of munitions. There are many details involved in it for which space will not be taken here; but it will pay plant managers to go into these very thoroughly with the inspectors. If a disposition is shown to comply scrupulously with requirements, arrangements can be made to facilitate the work and to pass upon the shell lots in groups instead of singly. Precautions can also be taken which will practically obviate any difficulty whatever.

The exterior of the shell is required to be painted with priming and finishing coats, according to methods heretofore described in THE IRON AGE, and the plug stopping the fuse hole is luted with some substance which will effectually seal the interior against any exposure to corroding elements; then all of the exterior except the copper band is coated for shipment with a thin covering of vaseline or other suitable grease, "which must be of such nature as not to interfere with gaging" or handling. The final operation is to pack the shells in cases, two each, with the heads laid opposite, and to mark the cases plainly to correspond with the invoices covering them.

CORRECT MARKING OF SHELLS DEMANDED

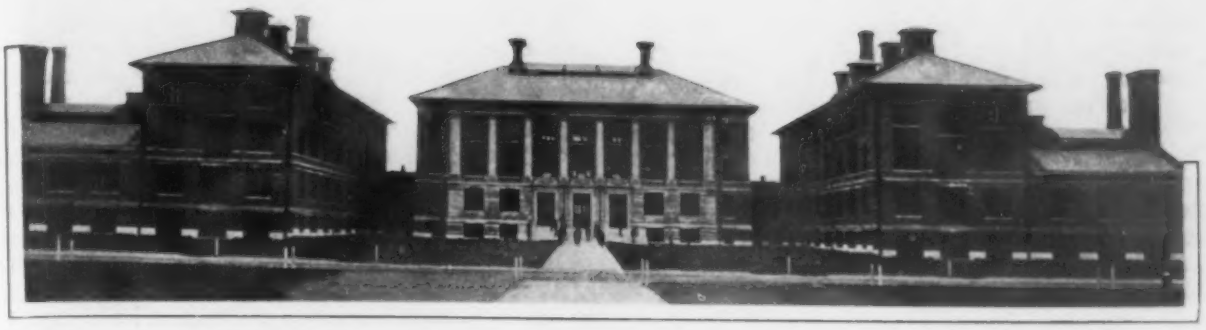
Meanwhile, at some convenient stage in the process of manufacture, the shells have been stamped with permanent marks of identification for use at the bases of supply and in the field. These serve the double purpose of distinguishing the nature of their use and also for any "comeback" that may be necessary in consequence of defects. They are shown in Fig. 4. The importance of care in such marking cannot be overestimated. It is related of the Russian campaign, during the retreat through Poland, that thousands of shells, in consequence of errors in marking, were sent to batteries for whose guns they were not fitted and had to be abandoned. Directions given to manufacturers must be carefully followed. The caliber, numeral, indicating letters and manufacturer's initials or mark, together with the date of completion of each lot, are stamped on the base of the shell, or on the side in front of the driving band; while numbers to identify the cast from which the steel was made, and the ingot, may be required to be stamped on the head. Such details as those last named were originally conceived to meet conditions in England, and the greater tonnages of steel put through on single orders in this country have led to various modifications here, but all essential features of specifications have to be closely complied with, as is proper.

As the shell goes to the gun in the field, it has a length of body 3.1 calibers, or 18.476 in. as a standard. This is the minimum dimension, a maximum of 18.78 in. being permitted. It does not include the fuse, whose length varies according to its character. The finished body diameter is designed as 5.96 in., with a permissible variation either way of 0.01 in., while the diameter over the driving band is 6.32 in., with the same degree of tolerance. There is a windage allowed-for over the body of 0.04 in. Weights and capacity must approximate the figures given in the accompanying table.

With suitable equipment and a contract of sufficient size to insure keeping it busy over the customary two-year period, together with the definite assurance of a regular supply of forgings, the production of 6-in. shells makes a better manufacturing proposition than that afforded by any of the smaller sizes. It is well worth looking into by anyone having the facilities for it.

Table of Weights and Capacity of a 6-In., 100-Lb. Shell

	Lb.	Oz.	
Empty body	87	4.5	
Driving band	1	15	
Total empty, unpainted	89	3.5	+ 7 oz.
Paint	..	1	—14 oz.
Bursting charge	7	14	
Fuse (No. 100 with gaine)	2	13.5	
Total filled	100	0	— 1.5 oz. + 1.5 oz.



The Making of a Skilled Mechanic

The Methods Used at Wentworth Institute to Teach Trades to Boys, and to Assist Journeymen Workers to Improve Their Position

WENTWORTH Institute, Boston, is a trade school whose aim is to fill the gap made by the breaking-down of the apprentice system in the metal-working trades. This it does by training its students under commercial conditions. Its foundry and machine shop are regularly filling commercial contracts and its pattern shop is equipped to keep pace with them. The same thoroughness that exists in teaching the metal-working trades characterizes the shops of the other crafts that are taught in the school. The school has an 8-hour day and the time and rate cards and shop discipline are those of a well-organized modern industry.

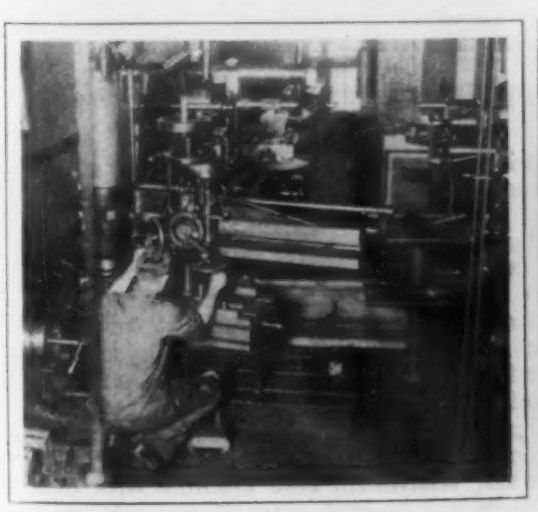
No effort is made to fit the boys to a textbook; every instructor has to be to a large degree a textbook for each boy. This produces an elasticity that enables the school to give to each student just the work—and all the work—that he is capable of doing. The brilliant student simply gets more work and more diversity of experience than his more plodding brother.

Applicants for the day courses must be at least sixteen or seventeen years old. For the one-year day courses and the evening courses no entrance examinations are required but the applicants must satisfy the principal that they are fitted by natural ability, practical experience or previous school training to succeed in the kind of work that they wish to undertake. Applicants for the two-year day courses must, in addition, pass examinations in arithmetic and English. The size of the classes is limited and a waiting list is maintained of those who are not able to take up the work at the time of application because of this necessary restriction. To exclude applicants not seriously intending to devote themselves to the learning of definite trades, a moderate tuition fee is charged together with fees to cover laboratory expenses and the cost of materials used.

THE COURSES OFFERED

The one-year day courses offered are: machine work, pattern making, foundry practice, forging, hardening and tempering, carpentry and building, electric wiring, plumbing and a trade preparatory course. The two-year day courses are: machine construction and tool design, electrical construction and operation, foundry management and operation, and architectural construction. There is a long list of evening courses consisting mostly of sub-divisions of the day courses. The evening courses have been designed to furnish education for men working at trades so that they may equip themselves to grow into more responsible and more remunerative positions.

The aim of the one-year day courses is to lay a broad foundation for those who intend to become skilled and intelligent mechanics. They include technical and theoretical instruction that is rarely obtainable even in a good corporation school and



In the Machine Shop the Boys Do Work on a Commercial Scale

the success of past graduates indicates that these courses are equivalent to two years, and in many cases to three years, in a shop.

The two-year courses are intended to train men for work requiring exceptional skill and a broad foundation—the men from whom manufacturers must recruit foremen and superintendents. The two-year courses make it possible to give more shop experience and some training in related trades and afford sufficient time to teach the underlying principles of applied science in a much more complete way.

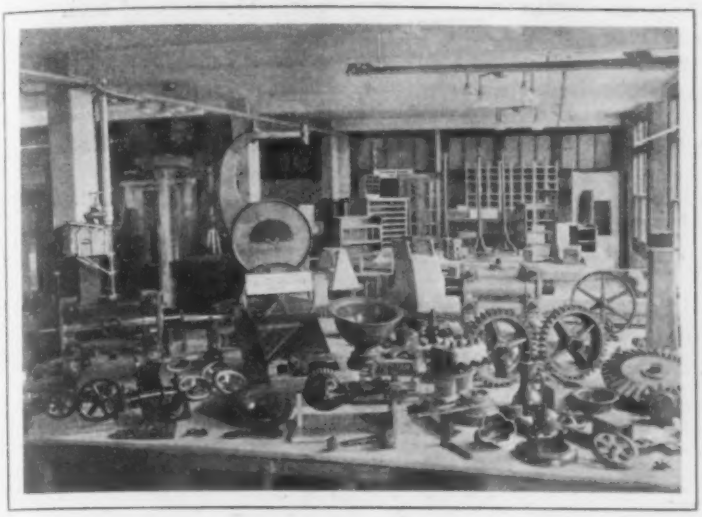
FOUNDRY PRACTICE

A brief analysis of the two-year foundry course will show the scope of the training a student receives. In a 40-hour week during his first year, he will give 7 hours to the study of applied science, the physical properties of foundry materials, the laws of heat, the flow of fluids and the mechanics of the foundry trade; 10 hours to theory related to foundry practice, cupola management and foundry chemistry; 4 hours to blue print reading and machine drafting for foundry practice; 3 hours to foundry computations, estimating and practical problems relating to foundry management, and 16 hours to shop practice, bench and floor molding for iron, brass and other alloys, machine molding, core-making, finishing, cupola practice, etc.

In his second year, the division of time is as follows: 7 hours to physical testing of foundry products and materials, strength of materials and advanced applied science; 10 hours to advanced foundry chemistry, sand testing, cupola management, mixing alloys, etc.; 4 hours to design of foundry equipment; 3 hours to advanced foundry computations and estimating, and 16 hours to advanced shop practice, floor molding in green and dry sands, sweep molding, machine molding and methods of rapid production. During this second year, each student is placed in charge of the different departments and in general charge of the foundry and thus is given experience in laying out work and handling men. In all his productive work a student is given practical tasks and held strictly to commercial standards.

Wentworth Institute lays much stress upon the chemical and physical testing of foundry products and materials and upon the applied science instruction, because these are the things lacking in the ordinary shop apprentice training in foundries. Foundry practice as a whole has moved forward more slowly than its related trades largely because of the ignorance of the average employee and his opposition to new methods, due to the lack of perspective that results from a narrow and one-sided training. The equipment provided for carrying out the course of instruction includes a Herman jar-ramming machine, Tabor roll-over, Tabor power squeezer, Wadsworth core machine with capacity for ⅜ in. to 7 in. stock cores, Wadsworth core oven, Millett protable core oven, 30 in. tumbling mill, Nor-

The Boys in the Foundry Course Learn to Make Molds in Green and Dry Sand, to Bed Patterns in the Floor, to Set Cores, and Every Variety of Foundry Work



Some of the Patterns Made in the Patternmaking Course and One of the Patternmaker's Lathes

ton floor-type grinding wheel stand, and a pneumatic hammer. Melting is done in a 28-in. Byram, Collieu type cupola. The brass furnaces include three pit furnaces using coke fuel and one experimental furnace using gas and compressed air. The total floor space available for foundry purposes is 50 x 100 ft., and of this an area 50 x 75 ft. is available for floor molding.

PATTERN MAKING

The pattern shop is thoroughly equipped with modern machinery and has much special apparatus and many special devices. The course covers one school year and besides giving a thorough training in the theory and practice of woodworking and pattern making, affords some instruction in foundry work, forging and machine work, and in the care and use of pattern-making machinery. One-half of the time is devoted to shop practice and the other half to drafting and laying-out patterns, shop drawing, practical mechanics and mathematics.

The instruction in pattern making includes the making of a great variety of simple and of single and multi-parted patterns, of built-up patterns and of core boxes. Demonstrations and practical talks are given in the foundry and the machine shop in order that the students may properly understand the relation of their trade to the practices of the allied trades upon the work which is first given definite form in the pattern shop.

One of the most interesting things in the pattern-making course is the close application of the applied science instruction to the actual needs and problems of the pattern maker. From one experiment the student derives the data and principles from which he computes the force necessary to anchor a core of a certain size in molds of given shapes. From another he learns to compute the pressure which molten metal will exert on the top of the flask and thus learns the advantage of designing a split pattern so that the upper part has as little depth in the cope as possible.

The work is made interesting at all times. For instance, one problem given to a class is to design a beam 24 in. long and of 2 in. cross-section, each student being asked to design the beam which he thinks will stand the greatest load. The patterns are made and the beams cast, then the class adjourns to the strength-of-materials laboratory and the beams are broken. One can imagine the keen interest of the boys and the pride of the winner.

MACHINE CONSTRUCTION AND TOOL DESIGN

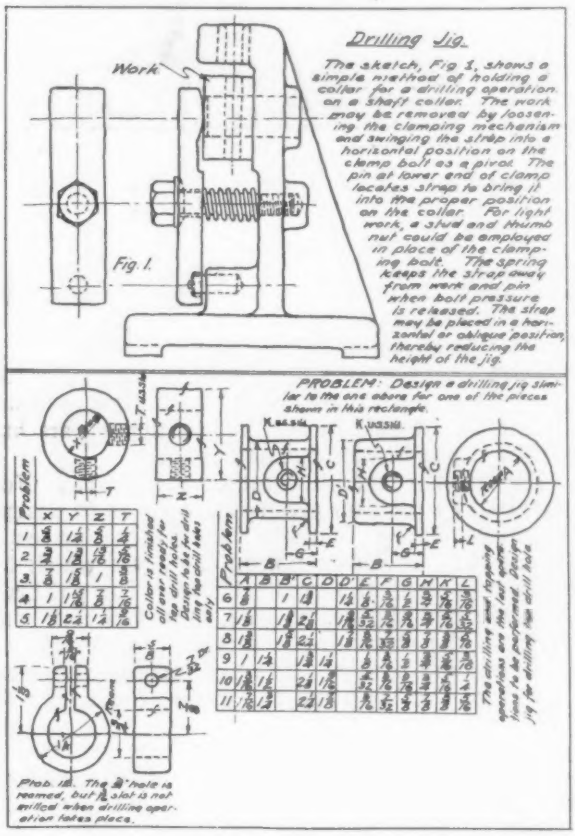
The equipment of the machine shop indicates the scope of the training a student receives. It includes: Twenty-three lathes, seven milling machines, two horizontal boring machines; two vertical boring machines, a 30 x 30-in. x 10-ft. planer, grinding machines of different types, radial and upright drills, shapers, gas furnace and oven, scleroscope and a generous equipment of surface plates, testing indicators, micrometers, verniers and fine tools.

The one-year course in machine work is planned to cut two years from an apprenticeship or to give a young man skilled on one machine an oppor-

The Methods Employed in the Building Trades Are Learned by Actually Doing the Work

tunity to become an all-round machinist. The evening courses offer this latter advantage, and also enable a man skilled in manufacturing work to gain skill and knowledge in tool making. Both courses are popular, for it is difficult under the industrial conditions of to-day to learn to operate more than one machine or, as is often the case, to learn more than one specialty on that machine.

While true of all the courses, it is particularly true of the two-year course that it gives a broad general instruction which will enable the student to enter a shop with a much higher earning power and a far better chance than usual of becoming


Drilling Jig.
Work.
Fig. 1.
PROBLEM: Design a drilling jig similar to the one above for one of the pieces shown in this rectangle.
Problem
Problem

A Machine Design Instruction Sheet, and a Set of Problems to Be Solved

a head workman or foreman. During his first year the student devotes 12 hours each week to shop practice in machine tool work, molding and foundry work, pattern making, forging and tempering; 8 hours to mechanical drafting, shop drawing and machine details; 5 hours to practical mathematics, shop computations and the use of formulas; 15 hours during two terms to practical mechanics, and 15 hours during one term to the principles of construction and operation of electric motors and electrical appliances.

During his second year the division of time each week is: 10 hours to machine construction and tool making, 8 hours to machine sketching and tool and jig design, 3 hours to advanced practical mathematics, 10 hours to steam and electrical power plant practice, 5 hours to applied mechanics, mechanism of machinery, materials of construction, transmission of power and power plant care and operation, and 4 hours to applied electricity, electrical machinery and power plants. The study of the related trades is not intended to give manual skill in them but serves to give the student an accurate knowledge and appreciation of the relation between machine construction and its allied crafts.

MECHANICAL DRAWING AND MACHINE DESIGN

There are few students who escape some contact with the drawing classes. The work of each course is planned carefully and logically to co-ordinate with the shop work of each craft.

The instruction sheet shown herewith is typical of the manner in which problems in mechanical drawing and machine design are presented. This shows a problem in jig design, one of those given in the early part of that special division of the work. The upper part of the instruction sheet shows a jig for drilling a pin hole in a collar, together with a brief description. In the lower part of the sheet several problems for solution are presented. The general principles of the design are illustrated but each of the problems is quite different from the solution presented.

Problem No. 12 on this instruction sheet also is shown as worked out by one of the students. Note that there is a similarity in design but that the final solution is quite different from the original presentation. An examination of the several problems will show that each has its peculiar feature, planned to bring out original methods on the part of the workman.

In the presentation of the mechanical drawing problems in the course, the instruction sheets are designed to teach the relation of views, the conventions and best practice in working drawings, and to develop good judgment in the student. The design problems are planned to systematically teach good mechanical construction, approved shop methods, and to develop originality.

The course in drawing and design is elastic in its nature and is so arranged that under each subdivision problems are presented in such a manner as to meet the ability and needs of the individual student. The variety of problems, insures individual work and effort on the part of the student.

THE COURSES FOR OTHER CRAFTS

Much could be said about the other courses offered by the school, especially the course in electrical construction and operation and the extremely popular evening courses. They are, however, too comprehensive to be described in a single article. Two courses, because of their uniqueness in trade school work, deserve especial notice. One, involving the use of structural steel and other building materials, is the two-year course in architectural construction. Organized for the purpose of furnishing instruction along allied building trades lines this course, now in its second year, promises to be of much importance. To train superintendents and foremen who appreciate architectural design and construction principles simultaneously with the ordinary processes of erection is an entirely new field and an important innovation.

The boys study the various representative types of buildings by means of lecture, testing, drawing and shop experience. The school keeps in touch with representative manufacturers, architects and contractors and the students will be valuable nuclei for any of the more specialized workers in the building trades. It is expected that they will combine some elementary skill with the ability to criticise, estimate, and design and detail the various operations of any building they may be on.

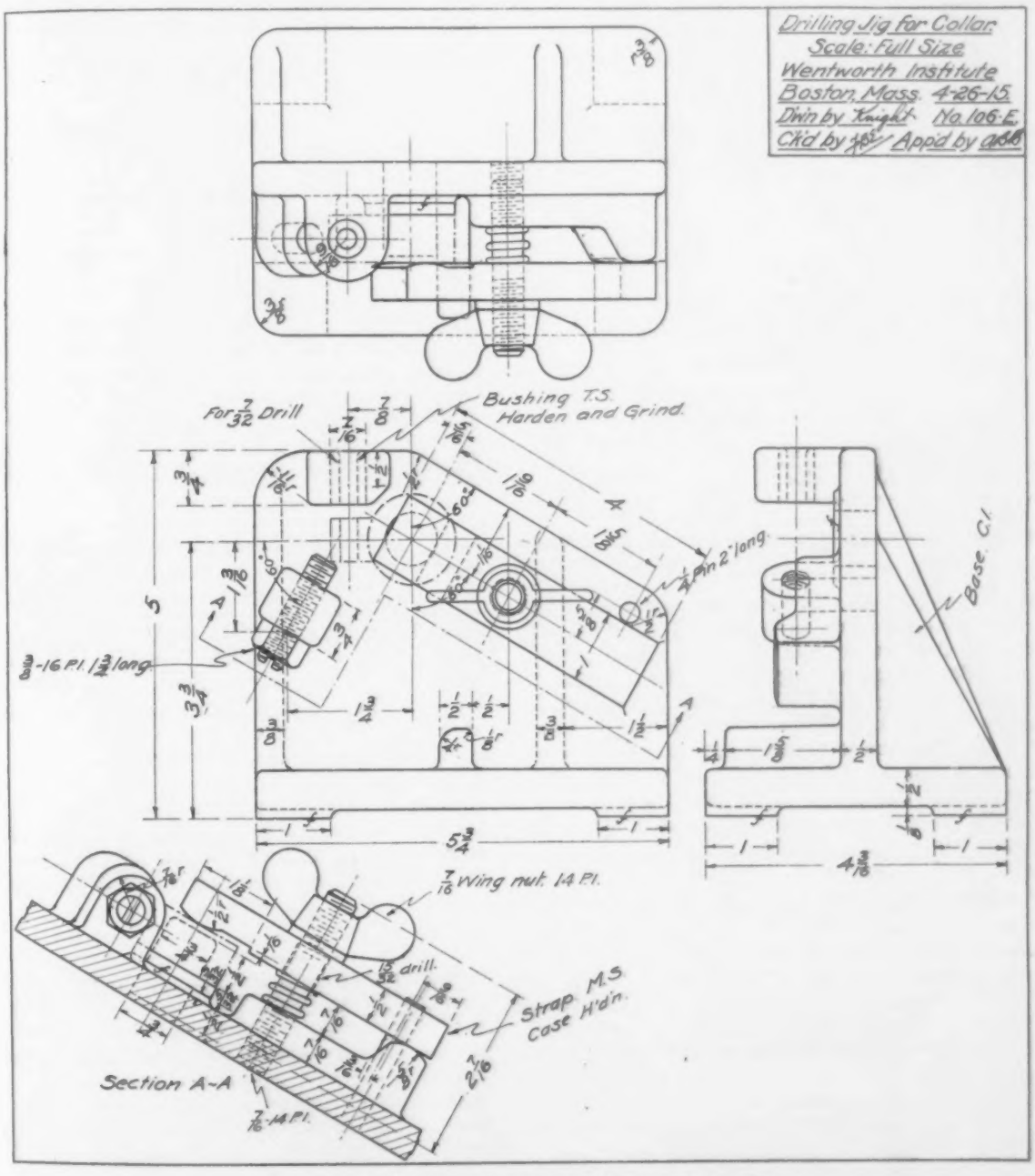
A one-year trade preparatory course is intended for young men who lack the practical experience necessary to meet the entrance requirements in other courses offered by Wentworth Institute. Experience has shown that there are many young men who wish to enter the school, who need to spend a year in such a course before they are fitted to

compete with the students admitted to the other courses.

HISTORY, LOCATION AND BUILDINGS

Wentworth Institute was founded by Arioch Wentworth, a citizen of Boston, "for the purpose of furnishing education in the mechanical arts." For this purpose he bequeathed the sum of $3,500,000, leaving the trustees unrestricted as to the main building, completed in the spring of 1914, is 66 x 132 ft. with four full stories and a gallery floor. Another building is now nearly completed which will be a duplicate of the first main shop and foundry.

Speaking of the expansion of the scope of the school which will be possible when this new building is ready for occupancy, Principal Williston said: "The day courses ultimately planned consist



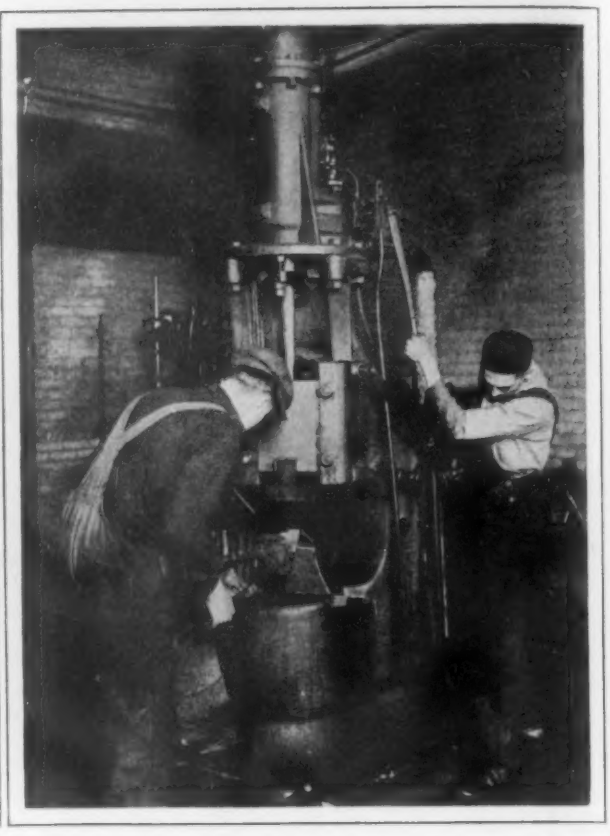
The Solution of Problem No. 12 in the Machine Design Course

lines of development or the policies of administration. The contract for the first group of buildings on Huntington Avenue, Boston, was signed on Oct. 17, 1910. The site contains over 12 acres, and is opposite the new Boston Museum of Fine Arts and is part of an educational center which includes such institutions as the medical schools of Harvard University and Tufts College, the Boston Normal School, Simmons College and the Boston Young Men's Christian Association.

The first group of buildings was completed in time for the opening of the Institute in September, 1911. This group included a main shop building, 49 x 145 ft., four stories, a foundry about 50 x 50 ft. and a power plant building 80 ft. square. The

of an extension of woodworking and pattern making, architectural construction, forging, and a course in power plant operation. The part-time and evening courses planned are a part time course for foundry apprentices, sheet metal work courses, painting and wood finishing, and telephone work. The new industries planned for are the bookmaking trades (including all kinds of printing, reproduction processes for printing plates, and bookbinding), and the boot and shoe industry. It is important that the school grow slowly in order that its growth may be substantial and permanent and that there may be time to properly study the conditions in each trade and make the necessary trade connections. We shall select first the extension of

Determining Strength of Built-Up Column Made in School

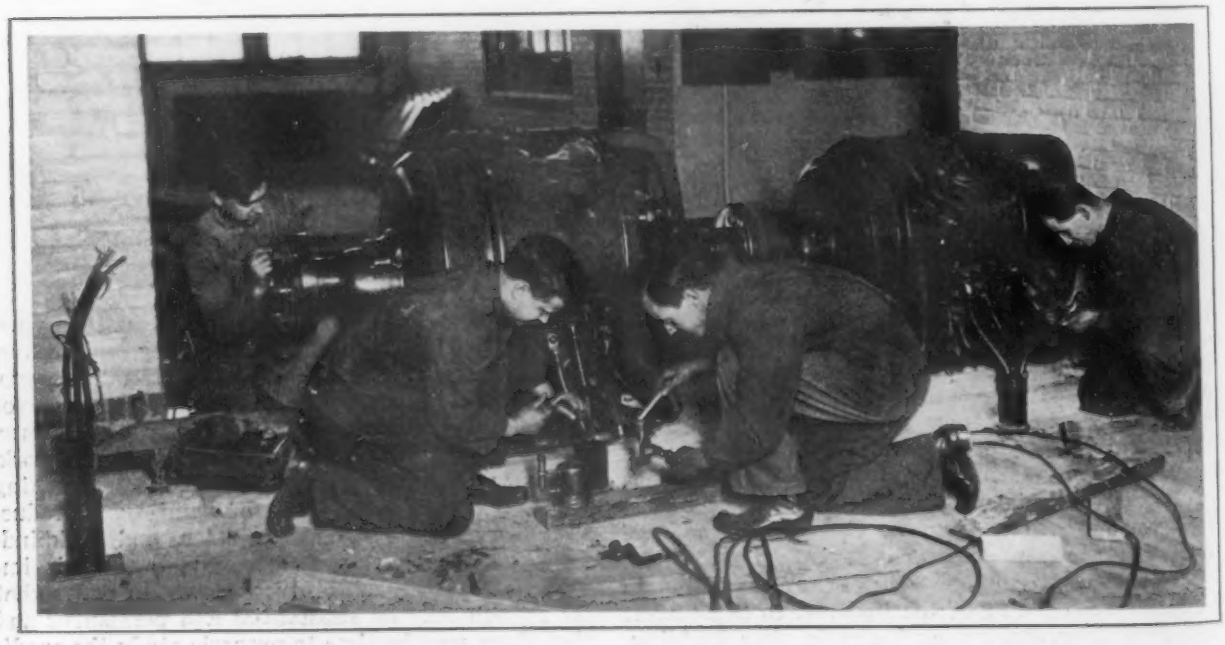


Learning the Fundamentals of Forging

pattern making and power plant operation, which are perhaps as much as we should undertake for full-time day courses for next Fall. Such entirely new undertakings in education as the departments for the printing and book making trades and for the boot and shoe industry should not be begun until they may be established upon a scale that will command respect and also not until very thorough preparation has been made for them and the friendly co-operation of the trade secured."

The aim of the school is not to teach a boy a man's work, but to give him a man's work to do. He is surrounded, as far as possible, with the atmosphere of the shop, not that of a school. The students are taught their trades on the machines and with the tools which they will use in their life work. The school has sought to reach those young men who have drifted into the working world at an early age and who have discovered how inadequate is their preparation for real and serious work. In this it has been successful.

The evening classes, and a large percentage of the day classes, are filled with young men who are working an eight-hour shift in some power plant or factory, or for the electric light or telephone company.



Practical Work in the Electrical Construction Course

War Work: Results in American Shops

What Improved Equipment and Methods Have Brought About—The Place of Munitions Machines When Peace Comes

BY C. A. TUPPER

C. A. TUPPER

WHAT have been the results, immediate and permanent, of the great swarming of American and Canadian metal-working plants into the manufacture of war munitions? What are to be the further results and how can advantage best be taken of them?

These are questions which are being asked in all seriousness by manufacturers on this continent, whether engaged in producing munitions proper, in turning out other war equipment or in the innumerable lines accessory to these.

In its effect upon the work of machine shops, particularly those equipped for large operations, the influence of the munitions industry has been very important. To realize this fully it is necessary to get clearly in mind the essential distinction between two leading methods of production. Most of the machinery turned out in this country heretofore has been "built" rather than "manufactured." The opposite was true only where absolutely standard types were produced in considerable quantities. Shops engaged in general lines, with products of varied patterns and sizes, presented little uniformity in their methods. In fact, pride has been taken in the so-called "engineering" character of the work, as well as in the ability of a concern to design equipment exactly suited to the character of the service required, no matter what the conditions of that service might be. The result was change upon change in drawings, patterns, castings and machining. Uniformity in the shop work was impossible, and its distribution among the various tools along any definite time-saving lines seldom proved practicable. This condition will probably continue to exist in large measure long after the war has closed. Any immediate change in general is far too much to expect; nor would the total elimination of "engineering" and "machinery-building" works be desirable. They serve their purpose very well in the production of equipment which is, and necessarily must be, special to a particular industry or process or to local conditions.

STANDARDIZING THAT HAS COME TO STAY

Among the large plants, however, whose profitable operation has heretofore been hindered by the desire to make every machine built an engineering triumph, the effect of turning out millions of munitions duplicated to hair's-breadths has been to standardize machine work in such a manner that a return to the old ways will be unthinkable.

Such plants were precisely the ones that needed the injection of some new, and in fact revolutionary, element like that afforded by munitions work. In numerous cases small shops or those of moderate size will be benefited from the same cause; but these have usually had less necessity for any radical changes. In the large plants, with their greater overhead, and with what seemed to be inevitable waste and lost motion, the need was fast becoming imperative. Not a few have been saved from actual or impending liquidation; and while the adverse conditions formerly existing were due in no small part to the long period of business depression, with only work enough for a fraction of shop capacity, the lack of "manufacturing" methods had been manifested unmistakably long before hard times set in.

To plants which were not organized as "manufacturing" units, the war orders came as a veritable godsend. They have been enabled first to get on their feet financially and secondly to learn how to secure the utmost from their equipment.

THE SINGLE-PURPOSE MACHINE

Nor did the good results stop with this; there has been an accumulation of benefits. As soon as the first rush to get started on the production of munitions was over, the managers of plants began to cast about for means of utilizing improved equipment. Among other things, the idea of single-purpose machines began to gain favor; and with it came the plan of utilizing semi-skilled labor to a greater extent than formerly, of introducing piece-work systems and related economies, as discussed in THE IRON AGE, Dec. 2, 1915, pages 1288-91. There was nothing new in this. It had all been carried out by automobile plants some years before. But the essential difference lies in the material and conditions with which munitions plant managers had to work. The rise of the automobile industry brought into being a set of machine shops which were nearly all newly built and equipped. After a period of trial, therefore, these were designed, furnished with tools and managed along original lines.

Old established lines of machinery production had, on the contrary, never been given such a chance as this. Most of the concerns engaged in them started in small shops which developed like Topsy. Plants were extended by adding a new building, a bay or a lean-to, here and there, with seldom any definite rearrangement of parts, and additional equipment was provided on the same plan or lack of plan. Even the construction of entirely new plants on new sites did not, as a rule, materially change the conditions; for much of the old equipment and practically all of the old methods—methods now being scrapped along with obsolete machinery—were carried over into the new works. Like the day-work of the carpenter-contractor, machinery production continued to be "building," not manufacturing.

MUNITIONS WORK PLANNING AS THE HEIR TO SCIENTIFIC MANAGEMENT

Scientific management essayed to change this, and in not a few cases it met with considerable success; but unfortunately some of the exponents of such systems created antagonisms which have militated heavily against any fair trial of them. This the writer can state with a degree of intimate knowledge from the experience of a large machinery-building concern with which he was formerly identified. There scientific management failed utterly, not through any defect inherent in itself but because of the manner of its introduction.

It looks now as though war work, through its exigencies, had taken up and would accomplish for some plants what scientific management alone was not able to put through.

In this it has numerous advantages. To begin with, the munitions industry started during a period of acute manufacturing depression, when hundreds of thousands of skilled men were out of work, when the treasuries of labor unions had been depleted of strike benefit funds, and when every one who counted for anything was glad to get back on a payroll somewhere on almost any terms. Men already at work felt very thankful to have employment. Consequently the great factor of active antagonism was practically eliminated, except in the case of a few tidewater plants. Even hyphenated citizens and aliens laid aside any feeling of allegiance to foreign powers, in order to keep employed.

Then the new methods necessary for munitions work started without any of the preliminary "talk" which has been the curse of the American metal working industries. It began with a rush, with an appeal first to Canadian and then to American ingenuity, and with a sweeping aside of time honored precedents, which carried all before it, contrary views notwithstanding.

In effect, it accomplished at a single stroke much of what scientific management had been patiently striving for, and it was able to take practical advantage of the work that scientific management had done. *In the final analysis it will be found that to scientific management is due a great deal of the credit for the improved conditions resulting from munitions work. During times of peace its really practical, constructive advocates were building better than they knew.*

RESULTS OF IMPROVED EQUIPMENT AND METHODS

Munitions work has also brought out, in a most spectacular manner, the importance of the improvements in shop equipment and methods which are the cumulative results of practices arising from the introduction of high speed steel. The résumé of these given in THE IRON AGE of Dec. 2, pages 1298-99, is so illuminating that many facts which might be treated to advantage in this article need no repetition here. The two should be read together. It may be stated, however, that the features mentioned by Messrs. Norris and Orcutt to which the greatest impetus has been given by munitions work planning are rigidity in machine design, as distinct from mere massiveness; more efficient and flexible drives, gear changes, etc.; greater economy of machine operation from improved bearings, better methods of lubrication and an ample supply of cutting fluids; and above all, the speeding up of idle movements and handling of material between cuts. In respect to all these, and particularly the group last mentioned, scientific management has played a part also; but progress as a whole has been chiefly due to the accumulating efforts of quite a number of practical plant managers, superintendents and foremen, the results of whose work have been freely placed at the disposal of the metal-working industries at large. In the manufacture of munitions, driven by necessity, these improved designs and methods have been eagerly seized upon and utilized to the fullest possible extent. So far as high-speed tool steel is concerned, the principal effect thus far has been a large increase in its use. In the composition of the steel some changes are to be noted, such as a certain substitution of molybdenum and other alloys for tungsten, in view of the scarcity of the latter; but this situation has not yet developed far enough to be set forth with any accuracy. The same may be said of stellite, whose possibilities are still largely a matter of speculation. All of the factors enumerated, however, have been given a degree of close, careful consideration by managers of munitions plants and have been practically applied to such an extent that the end of the war era will witness a very substantial advance in both the equipment and methods used by the machine shops of this continent.

Coincident with the benefits mentioned are others whose effects will be far-reaching, even though they may be overshadowed by larger elements at this time. Among these is getting American operatives better acquainted with the metric system and accustoming them more to fine gaging and to instruments of precision, the use of which was formerly confined to a limited number of industries. Such influences will be particularly felt in future export trade.

HEAVY FORGING PUT ON A BASIS OF RAPID PRODUCTION

Another of the important gains resulting from the munitions industry has been in standardizing forge shop operations and putting them on a manufacturing basis. This had previously been accomplished in the production of drop forgings, particularly for automobile parts, and also in factories where forging machines turn out work in large quantities, as in bolt and nut plants; but forge shops for heavy work have always been conducted heretofore on about the same plan as that of the village cobbler. Even the advent of hydraulic forging presses did not materially change this condition, although it facilitated the progress of the work. However, with the demand for an accurately formed forging at the rate of approximately one per minute, hour after hour, from each two-press unit, it became necessary to put punching, drawing and forming presses or other forging machines on precisely the same plane of production as a lathe or screw machine. The various details of the work which called for specific attention were brought out in an article on forging shrapnel cases printed in THE IRON AGE of Sept. 2, 1915. The influence of the greatly increased efficiency resulting has already extended to many other lines which have not the remotest connection with shell-making, and it will continue to be felt in increasing measure.

Furthermore, the new munitions industry, whether in the manufacture of shells, ordnance or auxiliary lines, has done more to extend the use of forging presses than many years of peaceful development would have accomplished. After witnessing in European countries, particularly Belgium and Germany, the remarkable development of hydraulic forging, the writer could not help but feel that Americans had failed to take advantage of the opportunities available for improving forge-shop work; but the end of the war will find us far along the path of progress in this respect.

Attention has been focused also upon the importance of the various auxiliaries of hydraulic press operation, such as pumps, accumulators, piping, valves. With-

Some Lasting Shop Results

An advantageous standardizing of work and the extension of "manufacturing" methods.

Larger use of single-purpose machines accompanied by scientific planning.

Putting forging presses on a rapid production basis and giving forge shop work a new status.

Better practice in annealing and tempering.

Extension of physical testing and of the use of alloy steels.

out proper attention to these, the efficiency of all forging units is seriously impaired; while keeping every detail in good working order and absolutely secure against leakage insures a high standard of production. In the presses or other forging machines themselves, alignment and rigidity of every part, as well as taking up the wear and adjustment of punches, dies, etc., are factors calling for constant care; while effective lubrication of every working surface, including the punches and dies, and the use of anti-scale compounds also constitute important elements of success. All such facts, of course, have been well recognized by efficient operators; but they were formerly not acted upon, in general, as they should have been. Under the stress of munitions work, indifference and negligence have given place to close, careful supervision.

ANNEALING AND TEMPERING REDUCED TO MORE EXACT PRACTICE

A further natural and inevitable sequence of the rigid requirements of munitions contracts has been to bring about the very general use of annealing furnaces and to secure more exact results from them, due both to the unremitting attention required in munitions work and to the greater application of scientific instruments, electric control systems, etc.

Tempering in all its details has likewise attained an importance heretofore given it only by a limited number of skilled tool makers and others similarly engaged. This is a branch of practical metallurgy in which our theory has been equal to the best, but apart from such work as tool-making our application of it was wofully deficient. Tempered steel of the finest grades had to be largely imported. In future there will be little if any necessity for dependence upon foreign sources of supply. With recent experience as a guide, our own skilled workers can fill all domestic requirements.

In this respect both the Canadian manufacturers, who were first to meet the acid test of new conditions, and the Americans who followed have reason to feel grateful for the strict, uncompromising character of European specifications and what seemed, at times, like the unnecessary severity of the first inspectors. The latter, it is true, might by more tact have avoided some antagonisms which did no one any good; but the net effect of their attitude in holding contractors strictly to the mark was very decidedly beneficial. It soon became a matter of *habit* to do the work so well that there could be no question about it.

PHYSICAL TESTING—USE OF ALLOYS

An immediate effect, also, was to increase the facilities and ability of the average shop, which took up munitions work, for making physical tests and analyses, as well as to bring about a far more adequate appreciation than formerly of the value of scleroscopic or other hardness tests as factors for determining what strains and stresses material will stand, and to make all physical characteristics of a finished product more a matter of pre-determination and precision than has heretofore been the case generally.

Of related importance, but due more to the demand for rare metals from abroad than to their actual need on this continent, is the greatly stimulated attention paid to the use of alloys—an attention which has done more to educate American metal workers in their effects upon material than any influence exerted for years past. It in turn has caused a lively search for the ores of tungsten—wolframite, ferberite, huebnerite and scheelite; for wulfenite and molybdenite from which to extract molybdenum; for stibnite as the basis of antimony production, and so on. This forms a chapter distinct in itself, which will have to be treated separately when the results are more apparent. The average manufacturer may feel, also, that it does not concern him largely. He is, perhaps, inclined to leave the matter entirely to specialists, believing that it is principally one of present reconciliation between supply and demand and prices which will adjust itself after the war. In this he is partly right; but what does concern him vitally is the fact that qualities and grades of alloy steels for various purposes are moving forward; and those who let the procession pass them may find it difficult to catch up again.

A subsequent result of stimulated production of rare metals in this country will be greatly lessened dependence upon foreign sources of supply. Immediately upon the conclusion of peace, or soon after that event, there will unquestionably be oversupply for a time and a severe drop in prices, with consequent suspension of operations where mining of the rare minerals is least profitable; but the situation can hardly fail to be gradually readjusted on a basis more satisfactory to all concerned than it was before the war. That much can be safely prophesied.

INFLUENCES AFFECTING EXPORT TRADE

While it cannot be foretold now with any degree of assurance what the effect on export trade will be when all of our competitors overseas "get in the game again," yet certain conditions have developed which at least give us a line on probabilities. Therefore it may be well to run through some of these.

In the first place, the tendencies toward greater economy of production along various lines, as noted above, will unquestionably bring American and Canadian manufacturers on more of an equality with European plants than before the war, both as the result of greater *average* labor efficiency here and lowered average efficiency abroad, coupled with rising labor costs in Europe. The writer formerly observed, especially in Germany, Switzerland and Sweden, that this average was what gave foreign producers their most important advantage; for what passed with them as unskilled labor at low wage rates was largely the equivalent of uncommonly efficient semi-skilled labor with us; and the rising scale of wages on both continents tended to accentuate the difference rather than to lessen it. In the judgment of competent observers, however, the war has altered the status of European wage-earners, and American skill can never again be offset by low labor costs abroad to anything like the extent formerly the rule. Even the spread of the eight-hour day here, as compared with longer European working hours, can hardly affect the situation materially.

Next we have to consider the fact that exports based on the very strictly maintained requirements of the warring nations have given American steel and

The Commercial Side

Rising labor costs in Europe will leave machinery manufacturers there with less advantage.

There will be no sudden turning back of munitions tools into regular channels and thus no shock to the industry, since munitions contracts will vary in expirations.

A very large percentage of such tools, completely amortized by munitions profits, and worn out by severe service will be scrapped. The second-hand trade, moreover, will need a restocking, having been swept bare.

machinery manufacturers a better standing in European centers and have put them in line for considerable business of a more than transient character; while for the minor powers the present war orders have made the United States and Canada established sources of future ordnance and munitions supply—a source from which our own Government can also draw when the need arises. Furthermore, American manufactured products generally have been introduced to more large foreign users than ever before.

FAVORABLE INFLUENCES AFFECTING THE MACHINE TOOL TRADE

As to machine tools, the effects of the war on foreign trade will be so conflicting that no advantage can come from discussing the subject in any detail in this article. Trade with the central European nations and plant owners elsewhere through the world who are in sympathy with them will probably languish; while with the countries of the Allies, their colonies and friendly neutrals, it should be greatly stimulated. In the countries on the borders of Europe the thousands of American machines newly installed for war work have made the French, English, Italians, Swedes, Russians and others familiar with our tools to a much greater extent than ever before, and they will probably be favored in future far more than in the past. The actual volume of the demand, however, will naturally depend upon the condition of foreign industries, the number of machines from munitions plants abroad that can be turned back into ordinary manufacturing and the purchasing power of factory owners.

Similar conditions will affect the domestic demand for machine tools; but undoubtedly in much less degree. Unless deliveries catch up with requirements to a far greater extent than now seems probable, the development of American industries will be likely to absorb all offerings for some time after the war closes —long enough, at least, to permit a gradual restoration to normal conditions. What will be done with the multitude of tools, especially lathes, now used for the manufacture of munitions, is a question that cannot well be answered at this time. Some will be absorbed into the industries of peace—largely without leaving their present locations—while a very considerable percentage can only be scrapped. In many plants, the way the tools are now being driven, they will be worn out and completely charged off or amortized by the time some munitions contracts are finished. In the final wind-up enough may remain to glut the second-hand trade; but it must be remembered that this trade has already been swept practically bare of the accumulations of years; and the stripping from metal-working plants generally of everything that has been standing around unused or could be spared for munitions work has cut off the regular future sources of supply for the second-hand trade. Furthermore, there can be no sudden turning-back of munitions tools into regular channels, for the reason that contracts will terminate, finally, at different times. Under all the conditions, therefore, the second-hand trade should be easily able to take care of what is left over from the manufacture of war supplies.

Taken as a whole, the effects of the European war upon the American metal-working industries far exceed anything of a transitory character. The lasting results will be many and varied. In the main they cannot help exerting a very beneficial and steadying influence. It is, therefore, fitting that manufacturers in these lines, each and all, should ask themselves the question: Are we putting ourselves in a position to get the most out of the new conditions; are we profiting from the experience of the leaders in various branches of munitions work? If not, they should seriously "think on these things."

Metals and Alloys in the Steel Industry

(*Continued from Page 23*)

produce better metal, the principal function of titanium being that of a deoxidizer. Aluminum has also been very largely used for this purpose but its present abnormal cost is practically prohibitive and for this reason, titanium has found a very ready welcome among the steel makers. Thermit ferrotitanium has risen somewhat in price, but this advance has been almost negligible. This alloy is having a larger use also by manufacturers of high-grade iron castings.

COBALT

There is considerable cobalt metal used by manufacturers of high speed tool steel and Stellite, and it has been generally acknowledged that the addition of a small percentage of this metal will produce a tool of greatly enhanced cutting qualities. It is growing in popularity although, as in the case of ferrovanadium, its fluctuations have been somewhat lost sight of in the rush for other more necessary alloying metals. Advances have not been very serious, and since Canada is the principal source of raw material supplies have not been seriously curtailed. The available deposits of cobalt ores are large and there should always be a sufficient quantity of the oxide obtainable, although reasonable fluctuations may be expected from time to time.

FERROVANADIUM

The vanadium market has not been directly influenced by the war abroad because the principal sources of raw material are in South America and Colorado. The price remained stationary for some time but has risen sharply within the last few months on account of the heavy advances of metallic aluminum which is one of the principal reagents employed in the production of high-grade ferrovanadium.

The use of this alloy has been steadily growing. It is used largely in high speed tool steels, carbon tool steels and steel castings such as locomotive frames, etc. Before the war, the vanadium market was quiet and steady at about $2 per pound, but as the price of metallic aluminum advanced from 20c. to nearly 60c. per pound, ferrovanadium kept pace and to-day it is quoted at about $3 per pound. Large quantities have been exported because Europe is entirely dependent on this country for supplies of this metal. The ores are plentiful and there has not been noticed thus far any particular scarcity of the final product.

Sheet Steel Piling Handbook

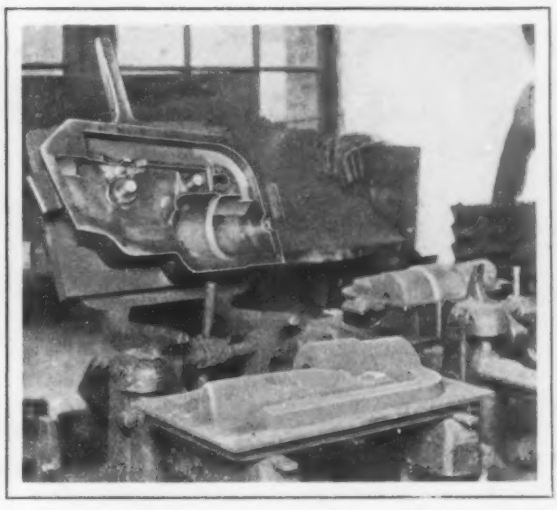
The tenth edition of a pamphlet on sheet-steel piling has been issued by the Carnegie Steel Company, Pittsburgh, Pa. It covers sheet-steel piling for use in cofferdam construction, retaining walls, mine shafts, sewer trenches and other construction work where wooden-sheet piling has been formerly used. Since the ninth edition was issued in 1912 the pamphlet has been revised and reset. Tables and data on the properties and uses of the sections rolled by this company, which are made in three different forms—the United States steel-sheet piling, Friestedt interlocking channel-bar piling and symmetrical interlock channel-bar piling—are given. The driving of the piling is discussed and brief descriptions of the various appliances employed are presented. Instructions on pulling of the piling are included. A general discussion of earth and water pressures is presented, and instructions on computation of bracing systems for cofferdams, retaining walls, etc., and notes on concrete and safe-bearing loads for piles are given. A number of tables of useful information, covering such subjects as the weights of materials for different types of work, lifting capacity of tackle and decimal and metric equivalents of the various measures of lengths, are included.

Jolt-Ram Machines for Light Castings

How Castings of Thin Section and Exacting Contour Are Made at King Separator Works—Special Pouring System

THE rapid increase in the use of mechanical equipment in connection with the processes of the rural dairy and the city milk distributing stations some time ago reached such proportions as to result in the creation of a creamery supply business. Among the apparatus used, the centrifugal separator is one of the more important pieces. Its functions require that it shall be built of accurately finished parts, while the conditions of marketing demand economical methods of manufacture to insure a profit in its sale. Sound castings having a superior finish for an enamel covering and a minimum allowance for machining that necessitates a nice uniformity in the size of the pieces as they come from the foundry, are a first requisite. From a groundwork of experience gained in the manufacture of a class of castings of similar character, the King Sewing Machine Company, Buffalo, N. Y., has developed methods for the economical production of separator cast-

View of the Gear Wheel Floor Showing the Special Pouring Device



The Machine in Which the Frame Cores Are Made and the Separator Frame Molding Crew at Work

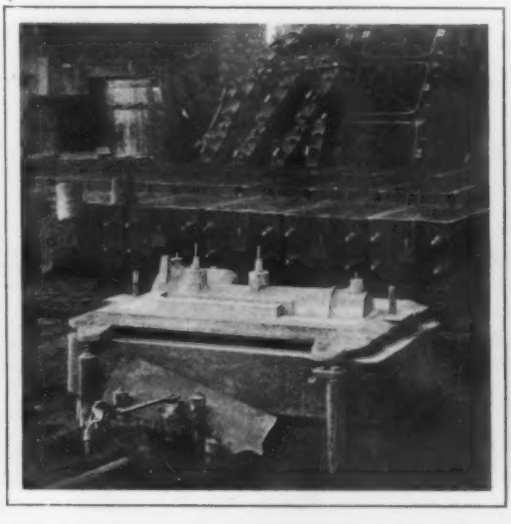
ings in large quantities. This development is largely dependent upon the adaptation of the jar-ram machine to this work, and with some of the interesting particulars this article will deal.

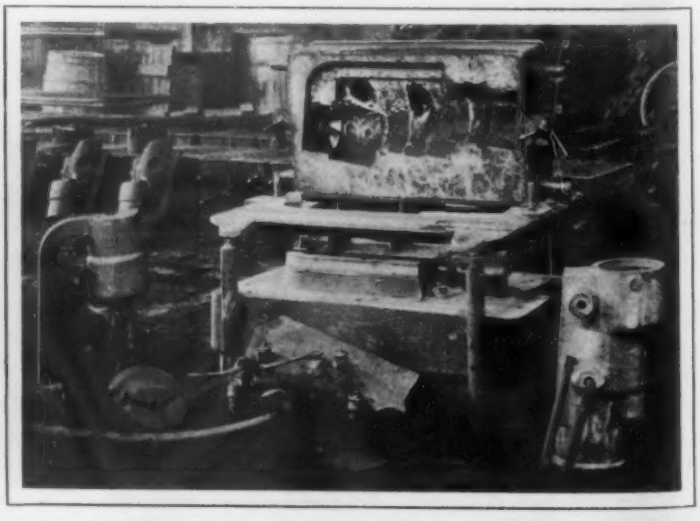
The main foundry building is 90 x 200 ft., with a cleaning room at one end which opens into the milling and grinding departments. At the opposite end a lean-to houses the raw materials, and an extension, 30 x 80 ft., at the side, provides for the coreroom. The melting unit, consisting of a No. 7 Whiting cupola, lined down to 54 in., is located in a wing that projects from the foundry floor, midway between the ends of the main building. The pouring floors of the foundry are laid out on either side of a 10-ft. central aisle extending from the aisle to the building wall on either side. A monorail conveying system with floor-operated, hand-power trolleys is provided for the distribution of hot metal and for the handling of flasks and other materials from storage to the molding floors. To insure the distribution of a maximum of natural light throughout the working day, the foundry was designed with a special form of roof construction, resembling the depressed-bay type but having a longitudinal monitor also and making the roof a series of Maltese Cross lanterns. With a minimum number of square feet of glass, the foundry thus receives the high light all day and is, in addition, particularly well ventilated. The foundry is heated with an indirect system of hot-air distribution which also serves in the warm months as a cooling system.

A gravity water supply system is installed for the tempering of the sand in the piles at the molding floors. A reservoir supply of water is maintained in a centrally-located concrete tank at a height which is automatically controlled by a float. From this tank the water is piped to a number of barrels conveniently located about the foundry floor at the same elevation as the central tank. As the water is taken from the barrels it flows from the central supply where the float controls the height of the water in all of the barrels. The possibility of the barrels overflowing and flooding the floor, a condition not uncommon yet attended with considerable danger where hot metal is handled, is thus entirely avoided.

To illustrate the general characteristics of the molding problems involved, the following description of the method of making the three heaviest and most important castings is presented. These consist of the frame, the base and the gear wheel. Views of the frame casting and the equipment with which it is made are shown, and similar views of the operations involved in the molding of the base are presented. These two castings are made on a group of six Mumford combination jolt, pit pattern-drawing machines marketed by the Vulcan Engineering Sales Company, Chicago.

Referring to the frame casting, the patterns are split and each half is mounted on a jolt machine with pit-draft stripping mechanism. As indicated in one of the illustrations, the pattern is bolted rigidly and directly to the table of the machine, the

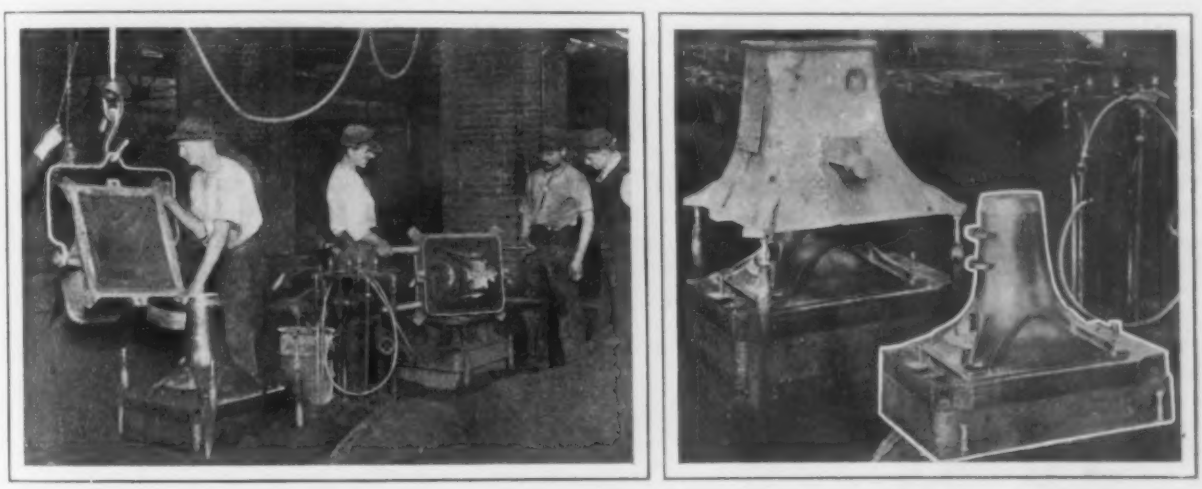




The Jar-Ram Molding Machine with Separator Frame Pattern Mounted and the Separator Frame Mold After Stripping

stripping plate being loose, and in another the pattern is shown mounted with the stripping plate in position ready for putting on the flask. The former illustration shows the flask stripped from the pattern and removed from the stripper, on the top of which it is left standing, on edge. The body and end cores are shown at the left of the machine, the resulting casting appearing at the right with the bearing cores. The flask for this job is 15 x 26 in., the drag being 7 in. in depth and the cope only 6 in. Notwithstanding this very shallow depth of flask and the fact that the casting weighs but 56 lb., the ramming of the mold is accomplished with uniform firmness.

A view is also presented of the gang of three men, including the core carrier, that operates the floor on which this work is done. This one man brings the cores to the work and sets them while the other two are molding. None of these men has had any previous experience with this class of work, and they are now turning out 155 molds as well as pouring off. With three men and no core setter 165 molds are produced, while with three men and a core setter 200 molds are produced daily. Thus an aggregate casting weight of from 8680 to 11,200 lb. is produced on this floor each day. As indicated in the illustration, two men are required to carry off each half mold. No bottom boards are used as planed cast-iron plates are set level in the floor.



The Two Jar-Ram Machines upon Which the Base Pattern Is Made and a Close View of the Pattern Showing the Lugs and Also the Manner of Removing the Drag Flask

The ordinary method of making work of this size and character has been to mount the pattern on a plain stripper, roll-over machine or split-pattern squeezer with stripping plate. It is apparent that with the pattern and equipment properly designed it is possible to accomplish a greater volume of work by jolting, even with a small size and weight of casting, than can be produced by any other method. The experience with these separator frames has indicated that such castings made on a jolt with a pit pattern-stripper on frames can be produced with marked uniformity both as to weight and size, considerations of great importance, in view of the fact that the castings are finished in automatic machines and must fit the jigs. It is estimated that the annual saving in overweight on castings made by this jar-ramming method, as compared with hand ramming or squeezing, has amounted to a considerable tonnage and a direct saving of several hundred dollars.

In the engraving of the machines on which the molds for the separator base are made, the drag machine is the one at the left, and the illustration shows a completed drag-half of the mold suspended on the air hoist. The cope is made up on the machine at the right and, being much smaller, no hoist is required as two men can readily handle it. No stripping plate is used on these machines, the mold being stripped direct from the pattern. The base, which has a cross-section of metal only 5/16 in. thick, suggests a rather difficult job of ramming to avoid soft spots at the point where the pedestal curves out to form the legs. As may be noted, air holes are drilled through the flask so that any tendency to form air pockets at the points where difficulty was likely to be encountered is avoided, and it has been found that the sand packs in uniformly.

Referring further to the drag machine, the pattern base is cast in one piece, as it was found that the original pattern made with the pattern proper cast separately from the base could not be kept in good working condition without excessive costs for repairs. The present pattern has proved highly satisfactory. It has two lugs, as shown in the illustration, and a novel feature involved in the making of this casting arises from the jolting of the mold with lugs in extended positions, then opening the door on the side of the flask, ramming sand firmly around them and closing the door, following which the lugs are thrown back by a special mechanism to permit of stripping. The completed drag is then raised from the pattern by the elevation of the four vertical rods on which it rests. From these supporting rods the drag is lifted by an air hoist. On this job four men and a core setter turn out and pour off 130 molds per day, the core setter having a large body core to place. The castings weigh 41 lb. each, and it is estimated that the production on the jar-ramming machine, as compared with other methods, results in an increased tonnage of castings amounting to at least 40 per cent.

In the casting of the gear wheel blank, a circular steel flask is used, and the work is done on a Modern molding machine built by the Arcade Mfg. Company, Freeport, Ill., the machine being of the air-squeeze duplex-pattern type. The view of the gear wheel floor shown also illustrates a special device in the form of a pouring rig that enables one man to pour all the iron, a 250-lb. ladle being used, while the others skim and shift weights. This pouring rig, as indicated, consists of a ladle ring suspended by a heavy bail and bell crank arrangement from the overhead trolley or crane, the vertical suspension member consisting of a turnbuckle for properly adjusting the height of the ladle to the mold for pouring, while the bell crank has a pawl and ratchet quick adjustment. On the

gear wheel floor the machine operator pours 2600 lb. of iron. The gear blank weighs 22 lb. and must be a perfect casting, the smallest pin-hole being sufficient cause for rejection. Other castings which enter into the construction of the separator are made on the various types of squeezers, and in the aggregate as much as 30 tons of metal has been poured from this foundry in a day.

The large number of cores required for the various parts of the separator renders the coreroom an especially important adjunct of this foundry. The core is made in halves and pasted together after baking in the usual manner. The two Pridmore roll-over core machines employed are mounted side by side, each machine making one-half of the finished core. The illustration of one of the machines makes apparent the essential details of the job, and it may be added that thirty bottom halves and eighteen top halves of the frame core are produced per hour by two operators, which, in view of the complicated nature of the core, is an unusually satisfactory production.

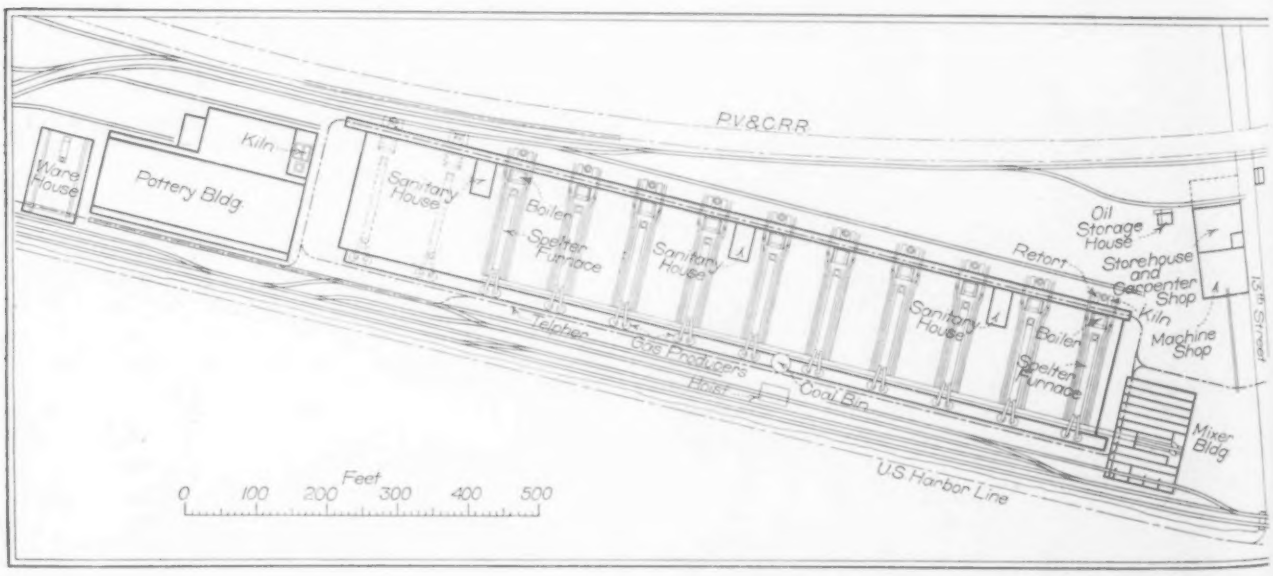
Particular attention is devoted to the cleaning of the castings in order that a smooth surface may be secured, and it has been found that both sand blast and tumbling mills yield their particular results which are respectively desirable according to requirements. The cleaning department is provided with a sand-blast room, sand-blast tumbling barrel and the usual square and round tumblers, all connected to a Sly dust collector. After grinding and chipping, many of the castings are painted by dipping before being transferred to the machine shop or being stored, a special paint tank with agitator being provided. Throughout the foundry the work is entirely on the piecework basis of remuneration and in the cleaning room it has been arranged on a gang-piecework basis.

The American Steel & Wire Company's Zinc Works

The Plant at Donora, Pa., Operated in 104 Days from Start of Building—Annual Capacity 40,000 Tons Zinc and 100,000 Tons Sulphuric Acid

PRODUCTION of zinc in 104 days after the start was made in excavation for the buildings is the record of the zinc works and acid plant which the American Steel & Wire Company has established at Donora, Pa. Work was begun on June 22, 1915, and the first zinc was turned out on Oct. 20, 1915. The making of sulphuric acid dates from Dec. 23. The plant was undertaken by the American Steel & Wire Company to insure a supply of zinc at all times for its own consumption, and at a cost that would be entirely independent of the wide fluctuations of the open spelter market. The company will not use the entire output of the Donora plant, and the remainder will be sold to the American Sheet & Tin Plate Company, National Tube Company and other interests of the United States Steel Corporation, which are consumers of zinc. The very high price reached about a year ago for spelter, about 27 cents per pound, was also largely an incentive for building the plant.

When the entire plant is completed it will contain ten furnaces with an output of 40,000 tons per year of zinc and about 100,000 tons of commercial sulphuric acid. It is expected that the American Steel & Wire Company will use one-half or more of the 40,000 tons when the maximum output is reached. Plans for the plant were drawn by



MAP OF THE ZINC WORKS AND ACID PLANT AT

engineers of the American Steel & Wire Company, and the result stands as a notable record of what may be done in a short space of time in design as well as construction.

A site of 40 acres was selected, located between the Monongahela division of the Pennsylvania Railroad and the Monongahela River, the plant running practically north and south. It is located immediately adjacent to the wire and rod mills of the American Steel & Wire Company at Donora, the two blast furnaces and open-hearth steel plant of the company being further south, up the Monongahela River. The plant is served for receiving and

discharging materials by the Monongahela division of the Pennsylvania Railroad. The supply of water is obtained from the Monongahela River, coming from the pump house of the wire mills adjacent. Water is distributed throughout the plant by one high-pressure line, 10 in. in diameter, and a low-pressure line, 16 in. in diameter, driven by two 6,000,000-gal. centrifugal pumps. The acid plant is a three-unit type, each unit comprising a tower building, an acid chamber building and two roasting furnaces.

The coal for the plant is raised on the coal hoist at the open-hearth steel works of the American Steel & Wire Company, and is transported into the plant over its interurban line in steel hopper cars. The coal from the hopper cars is elevated to an overhead bin by a skip-hoist arrangement from which it is distributed to the gas producer bunkers by a distributing larry.

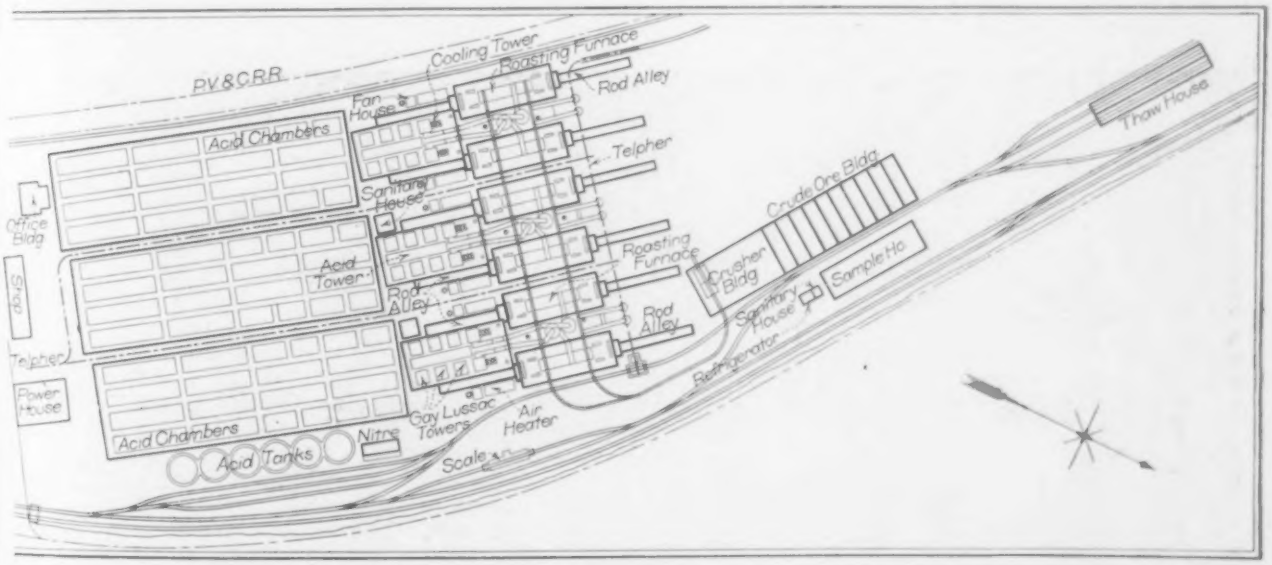
All the ores are received on the Monongahela division of the Pennsylvania Railroad, the ores now used being carbonate ores from the Western States, but it is the ultimate intention, when the plant is fully completed, also to use sulphide ores from Montana and Australia. At this point it is interesting to note that the sulphide concentrates are much higher in zinc content than the carbonate ores, and in addition they permit the recovery of the by-product, commercial sulphuric acid, which domestic carbonate ores do not.

The Australian ores are received in a closed box car under government seal, which is not broken until the ores reach their destination at Donora, and the car is then opened by government representatives, the ores being shipped in bond which, of course, can be released only by a government official. The cars containing the ores are weighed

The roasting furnaces are 20 x 80 ft. in size, with the most modern improvements installed in the furnaces proper and their machinery. Each furnace is double, seven hearths high, the dimensions of each hearth being 26 x 20 ft., making 6800 sq. ft. of hearth area to each furnace. The interior arches of the roasting furnaces have considerable spring, beeing built of tongued and prooved brick, and special brick is laid over each row of skewbacks to carry the weight of the rabble.

The rakes are of the usual type used in this class of roaster. The rake rods are jointed in sections, thus allowing easy replacement of any part. The rods are drawn through the furnaces by endless chain. The ore is charged into the roasting furnaces at the top, and it is raked back and forth on the different hearths until it reaches the lowest, from which it follows to the cars in underground tunnels, and is conveyed to openings from which it is raised to the telpher system. Each roasting furnace is supplied with gas from a mechanical gas producer, each of which is rated at 2000 lb. coal per hour gasified. Sirocco fans are used for furnishing air. The air absorbs the waste heat of the gases, passing through an air heater which is composed of cast-iron U pipe. It is found that the use of preheated air gives good results and works economy in the consumption of fuel. About 55 tons of ore are roasted per day, or 16 lb. per square foot of hearth area, with coal consumption of 12 to 15 tons.

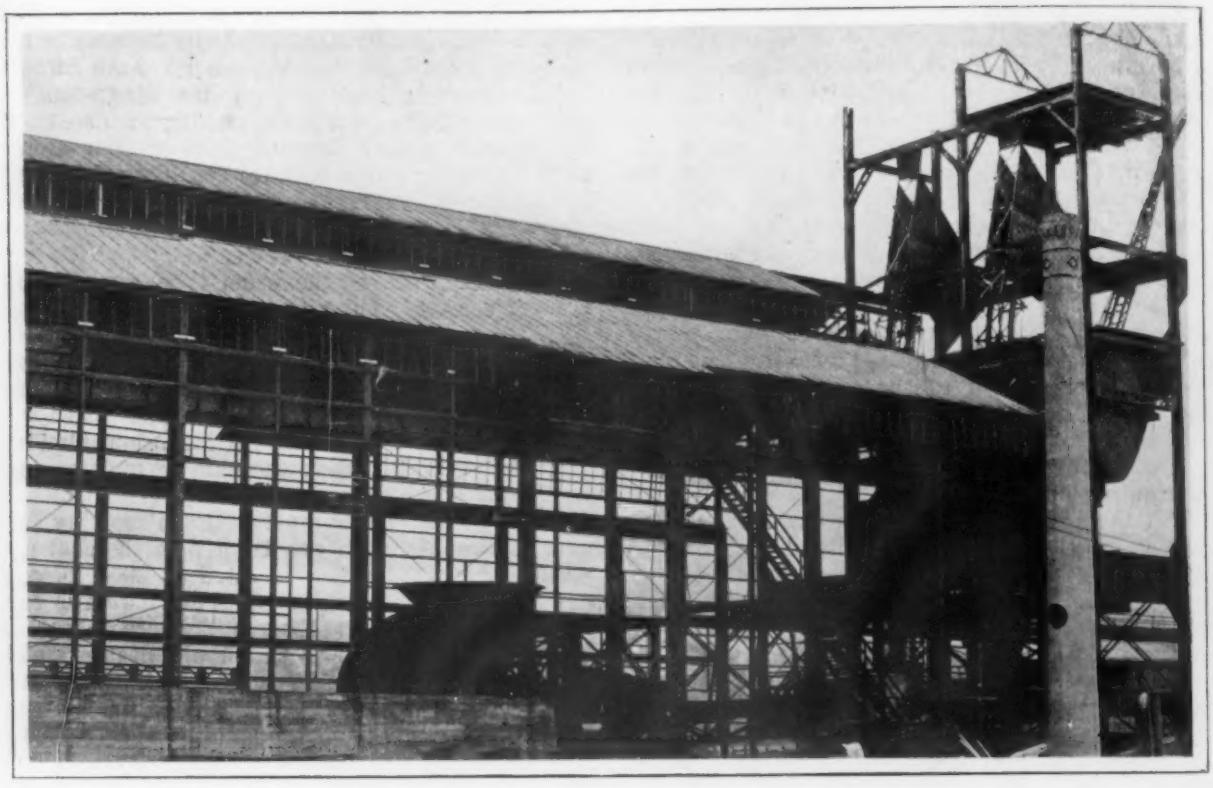
The sulphuric acid department is contained in three buildings, of steel and firebrick tile construction. The tower building is 71 ft. wide by 150 ft. long, and the chamber building is 138 ft. wide by 440 ft. long. The roasting furnace gases on leaving the furnaces pass through a centrifugal gas



DONORA, PA., OF THE AMERICAN STEEL & WIRE COMPANY

on a railroad track scale of 150 tons capacity, and the ore is then unloaded into the ore bins, of which there are ten, the dimensions of each being 70 ft. long, 20 ft. wide and 16 ft. deep, and each has a storage capacity of about 2000 tons. The crude ore building is equipped with a 15-ton overhead electric traveling crane with grab bucket. The ore is deposited in bunkers over a rotary screen, the fines passing through and the coarse ores returning to a gyratory crusher. The ore then enters a cylindrical drier, from which it is then elevated into a system of bins. Each drier is equipped with a drying furnace.

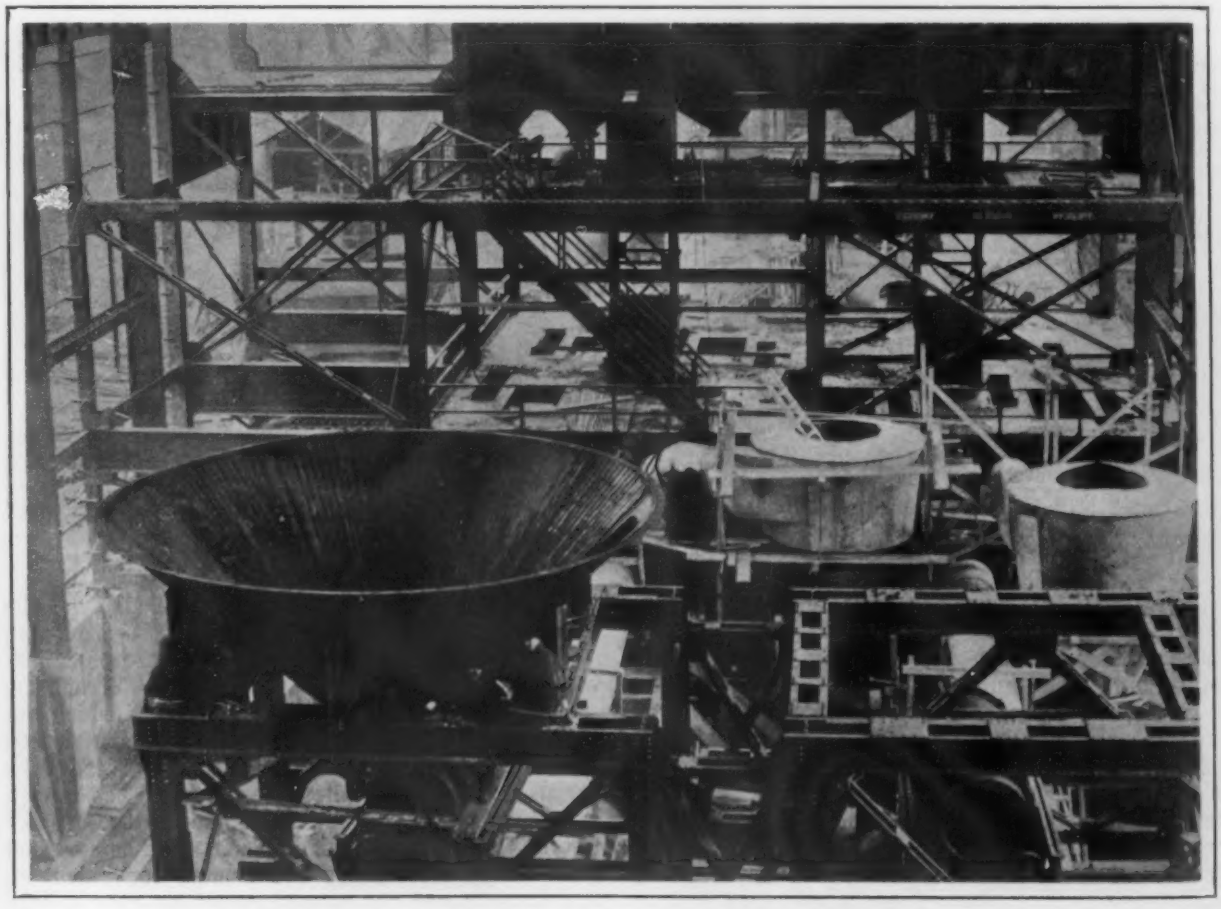
chamber 30 ft. high and 20 ft. in diameter. The chamber has a hopper bottom, the gases passing to a tower and condensing through ten lead chambers which have a space of 360,000 cu. ft. From the chambers the gases pass through towers which are 14 x 14 x 40 ft. in size. All towers are packed with special chemical brick. Two hard-lead fans are used for forcing the gases through the towers and chambers. The acid is pumped to the tops of towers from the acid eggs by means of compressed air. Large steel tanks are located convenient to the railroad and the acid is loaded by gravity into tank cars. There are six steel storage tanks erected



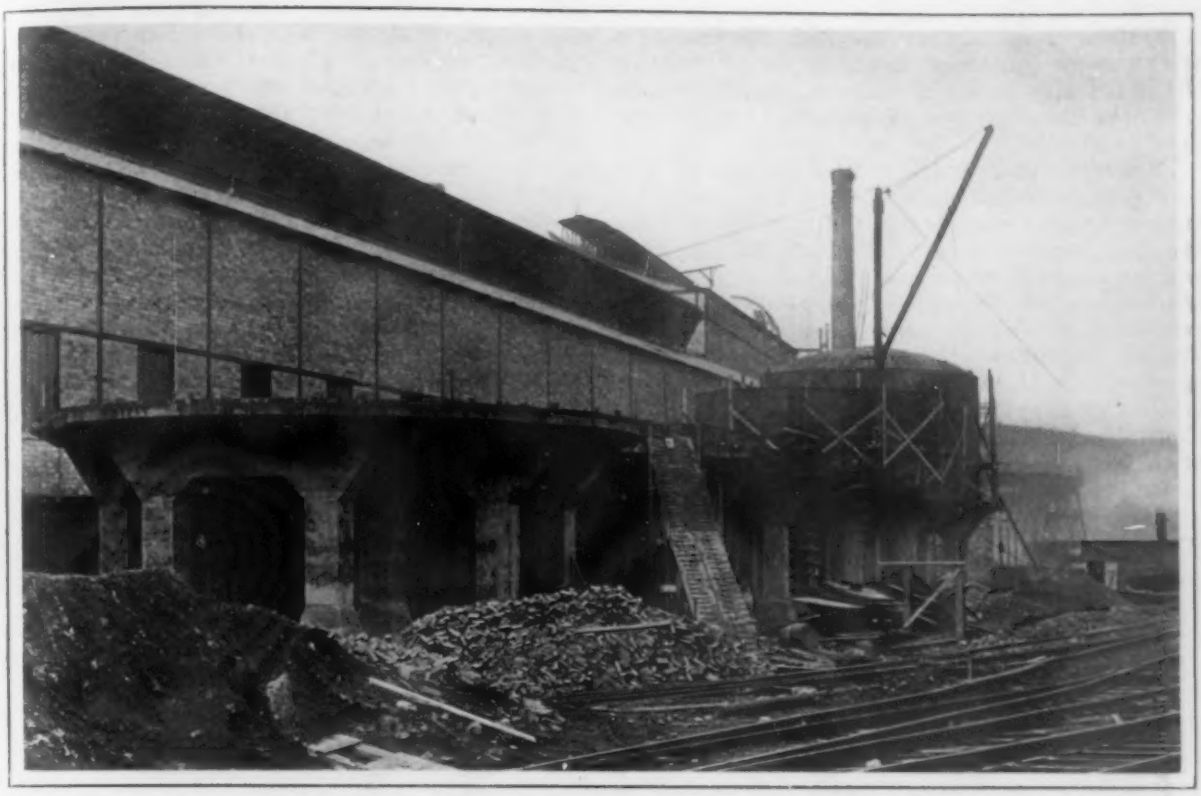
West Side of Crude Ore Building on Dec. 9, 1915; Ore Storage Bins Under Construction

on reinforced concrete platforms, each tank having a capacity for storing 1250 tons of sulphuric acid while awaiting shipment. The first sulphuric acid was made at the plant on Thursday, Dec. 23, 1915.

By means of a monorail telpher system the ore is taken from the roasting furnaces to the mixing house and deposited in reinforced concrete bins. This building is equipped with an overhead traveling crane, which lifts the roasted ore into steel bins from which it is drawn in proper amounts to a larry car with weighing bins. The proper proportions of ore and culm are deposited in two mixers and thoroughly mixed. From the mixers the mix-



Ore Hopper for Feeding Ore to Dryer in Crude Ore Building, Dec. 9, 1915



Number 1 Acid Tank Practically Completed on Dec. 9, 1915, and Number 2 Under Construction

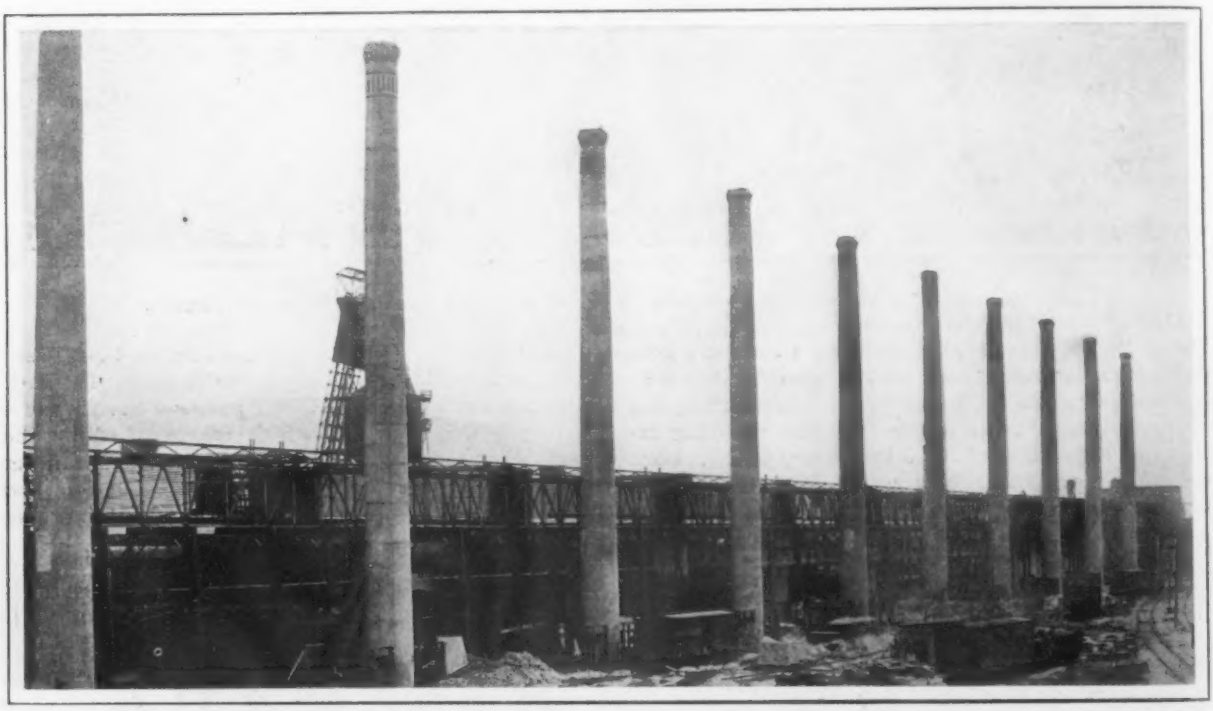
ture is placed in charging buggies which are conveyed by a transfer car to the spelter furnaces. There are ten spelter furnaces each containing 912 retorts of 8-in. inside diameter. The smelting capacity of each furnace is 10 tons every 24 hr. Each is equipped with two mechanical producers, 10 ft. in diameter, which furnish the necessary gases.

The furnaces are placed parallel at 95-ft. centers, each building having a width of 70 ft., thus allowing about 25 ft. of space between the furnaces for light and air, and which is also used by the workmen as rest rooms. The building containing the spelter furnaces is of all-steel construction, and is covered with asbestos protected corrugated metal,

Acid Chamber Building, Dec. 9, 1915, Showing Lead Pipe Connections and Wire-mesh Flooring

this being done to protect the steel and add to its life. Over each furnace has been constructed a steel canopy to prevent draughts of air freezing the liquid zinc in the condensers. Counterweight doors are used between the outer and the working floor.

The waste gases from the furnaces pass through a 588-hp. vertical water-tube boiler, which is equipped with a superheater and thence to a radial tapering concrete reinforced stack 125 ft. high, with an inside diameter of 5 ft. at the top. One of the construction features of the furnace is a flat roof arch laid at the same slope as the retorts. The buckstays are connected with tie-rods through springs, thus allowing for expansion. The bottom of the buckstays have all ball and socket joints, allowing movement in any direction. Another variation from usual design is a large pocket directly under the furnace, allowing room for the accumulation of several days' residue, and a tunnel under the pocket allows for its easy removal. This arrangement of tunnel and pocket eliminates all possibility of up-draft in the front of the furnaces. The spelter, after being cast into molds, is taken to the warehouse for storage, and in the warehouse is located a remelting furnace.



Numbers 1 to 10 Spelter Furnace Buildings; Coal Handling Plant at Left Background

The pottery is contained in a brick and steel building, 121 x 289 ft. in plan, with a machinery lean-to of 66 x 128 ft. In the main part of this building are located the drying rooms, twenty-four in number, with an alleyway at one end for charging and a loading platform at the other for loading retorts and condensers into cars. The rooms are heated by steam piping under grated floors. The air from the dry rooms is taken out through galvanized air ducts through the roof. The machinery lean-to is equipped with wet and dry pans, pug mill, condenser machines and retort presses. The pug mills and retort presses are used for making retorts and the condenser machines are used for making condensers.

The retort clay is received and is first passed through the dry pans and thoroughly ground. From the dry pans it is conveyed by a bucket conveyor to overhead bins from which the different clays are drawn in proper proportions for mixing on the mixing platform. The mixed clay then passes through the wet pans and is taken in mold form to the rotting rooms for seasoning. From the rotting rooms it is passed through the pug mill and condenser machine and from thence to the retort press. The capacity of the pottery plant is 1000 retorts and 300 condensers every 24 hr.

The power house is contained in a brick and steel building, 57 x 80 ft. in plan, and the equipment consists of feed pumps, air compressor and rotary converters, with switchboards and transformers. The current for running the plant will be received from the power house at the open-hearth steel works of the American Steel & Wire Company, being delivered at 2200 volts and stepped down to 220 volts for plant consumption.

It is contemplated to build a thaw house for thawing out ore in the cars upon receipt. A standard gage railroad track will be run through the center of this house and the temperature in the building will be run up to about 150 deg. Fahr. or more. A plant will probably be built for treating the retort residues and for recovering zinc in the form of oxide.

The company has paid special attention to the installation of sanitary appliances around the plant, these including bubbling drinking fountains, lavatories, shower baths and steel lockers for the men. Later on there will also be installed modern laboratories for sampling the ores. At the present time four spelter furnaces out of ten are in operation, making from 1000 to 1200 tons of spelter per month, and sulphuric acid in limited quantities is also being made. There was used in constructing the different buildings 12,000 tons of fabricated steel, all built by the American Bridge Company.

The Burd High Compression Ring Company, Rockford, Ill., manufacturer of a special type of piston ring in which the joint between the ends of the ring is guarded, has recently completed its new factory. The building is one-story monitor type, of fireproof construction, 129 x 190 ft. The plant employs 250 men and has a daily production of 25,000 rings.

After the War:
What of the New Munitions Plants, the Machine Tool Export Trade and Wages?

THE new munitions manufacturing plants are not likely to be seriously disturbing factors in the machine tool or metal-working fields at the close of the European war. The consensus of opinion of a number of machine tool builders is that the cessation of hostilities, when it comes, will amount to a truce rather than a lasting peace and thus that the demand for war material will continue strong, not to overlook heavy contracting for war supplies by this country; also that even if the machinery is not well worn, the type of these plants does not lend itself readily to conversion to other lines of manufacture, assuming that general conditions in this country might then warrant. It is the exception and not the rule that any of the closest students of the subject believe there will be dumping of used machinery in quantity; instead it is held that such is the treatment the machinery has received through the rush of the demands and the inexperience of labor that the machines will be ready for the cupola. Many machine tool builders are more concerned about what will be done by the new comers in the machine-making field than by the threatened oversupply from munitions plants.

Exporting will need to be done in the face of severe competition. A number of machine tool manufacturers, indeed, consider tariff protection necessary. Here and there mention is made of the importance of investments of American money in foreign lands if selling for foreign account is to amount to much, while buying by the belligerents in the reconstruction period is likely to be checked by credit questions.

Few believe that munitions work has brought about improvements in shop equipment or methods, unless it is that more metal-working establishments have learned of the heavy cutting work which may be done by special purpose tools of rugged construction.

A readjustment of hours and wages is expected, but not necessarily a full return to the conditions existing before the war. A number of manufacturers point out that a continuance of good business and a re-enactment of tariff laws are necessary if much of a reduction is to be avoided.

Questions Asked Manufacturers in Machine-Building and Metal Working Industries

To obtain the views of those most vitally interested in the effect of certain war conditions on the metal-working and machine-building industries, particularly as to the situation after the war, THE IRON AGE addressed a number of questions to leaders in these fields and secured replies of which the foregoing is a brief summary. The questions are given immediately below, and following these are some of the replies:

What will be the effect of the large amount of new construction of plants devoted to munitions, and which presumably will be looking for business after the war?

What will be done with the vast number of tools, presumably lathes, now used for the manufacture of munitions or for the manufacture of tools to make munitions?

What of the future of our export trade in machine tools?

Has munitions work brought about any lasting improvements in shop equipment and methods?

To what extent will the present unusual shop conditions, particularly as to hours and wages, outlast the war?

The answers, substantially in full, are as follows:

Frederick A. Geier

President Cincinnati Milling Machine Company, Cincinnati

Conditions in 1915 of course were abnormal, inasmuch as American machine tool builders had to meet the most extraordinary demand because of the war. I feel safe to say that the demand in 1915 was more than double that of any previous high period. On certain machines, classed as machines for making guns, rifles, etc., the increase in the demand was many times that of the standard machine tool.

The demand induced many concerns heretofore not engaged in the manufacture of machine tools to enter this business. No doubt some of these will continue to be a factor in the future, while many others, with the return of normal conditions and normal prices, will find the machine tool business not so profitable as other lines in which they were heretofore engaged.

With some exceptions the machine tool manufacturers have not had a very profitable business for many years past, the competition in the trade, together with the constant demand on the part of the user for improved machines, making it impossible to get the business on a really profitable basis. For instance, you no doubt know that if it had not been for this war some of our older companies would have gone to the wall.

For the future it is somewhat difficult to make predictions. The machine tool industry as a whole has had in the past quite a considerable foreign trade, which, however, had shown signs of diminishing five years previous to the war. Germany has been the chief competitor that has been making rapid strides, not only supplying her own market very largely, but being the great competitor for the neutral markets. Germany's exports were largely to Russia, France, Belgium and England.

In the period immediately following the close of the present war I have no doubt that the German exports to these countries will be cut off, and therefore, temporarily, the American exports of machinery to these same countries will probably be increased. If, on the other hand, the cost of production in Germany in the period following the war and thereafter will be lower than the cost in the United States, it will not be long before the price question will overcome the sentiments on the part of the countries mentioned against buying from Germany.

Generally speaking, I think we must look forward in this country to an ever-rising cost in wages. This will probably necessitate further developments in the design of machine tools looking more and more toward automatic processes, in order that the higher wage cost per hour may be offset by a higher production per hour. If the latter view is true, there will be considerable business for machine tool builders in years to come, but I fear it will be, as illustrated, along the

lines of more highly specialized machines, which will call for a large expenditure of capital and much in the way of engineering on the part of the American machine tool builder.

W. A. Viall

Secretary Brown & Sharpe Mfg. Company, Providence

As far as the writer sees the future, these large munitions plants, which claim they have business to last four or five years after the war anyway, will undoubtedly have to look for business, and of course the question comes up as to how far our own nation is going to provide itself, and keep itself provided, with arms. To turn these factories over into other lines of manufacture will not be an easy problem, and it looks as though the tales that are current, stating that the contracts are being taken at prices that will pay for these buildings and equipment, lend color to the probable attitude of the owners that they consider that their equipment will be of no use after present demands are supplied, so that it may be that they will fall into disuse.

As to the tools, if the factories are not used and there is no prospect of using them, undoubtedly the market will be flooded with certain classes of tools.

As to export trade, this is the most puzzling question of all. Undoubtedly Germany will make a great drive for foreign business, but her market will be limited. Many of the foreign equipments will probably be so thoroughly used up that a good deal of machinery will be required immediately after the war, but generally speaking, there will be a severe competition with foreign nations—much more severe than we have felt before.

From our knowledge of things and from what we learn of the way that some of these munitions plants are working we should feel that there had been little contributed to shop methods and practices that any of them would be very proud of. This is a thought based upon conditions that are existing to-day, but we may possibly be able to change our mind before some of these contracts are finished.

The present unusual shop conditions as to hours and wages will not last very long; in all probability they will change immediately the demands in these big shops decrease.

One of the most disturbing influences in the machine-tool business as we see it is the starting up of a lot of relatively irresponsible and inefficient machine-tool builders, who will probably hang on endeavoring to get business, these businesses largely doing a very ordinary class of work, presenting nothing in the way of inventive conditions to the trade.

George I. Alden

President Norton Grinding Company, Worcester, Mass.

I think the answers to most of the questions you ask relative to what would occur at the end of the war depend very largely upon how the war ends. If peace should be arrived at which is obviously merely a truce, then I think all the countries will continue to pile up war munitions for some time. In that case the new plants devoted to munitions would probably continue in business, and the tools, such of them as were not worn out and fit for the scrap heap in that time, would continue in use for the same purpose; on the other hand, if peace which looks to be reasonably permanent should be secured, all the countries will naturally turn their attention to regaining their trade and improving their conditions generally.

The extent to which the United States may be called upon to furnish material and manufactured products to replace the destruction in Europe caused by the war it seems to me will depend largely upon the rapidity with which these countries attempt to accomplish this work and whether they decide to try to do most of the work at home or not.

We shall probably continue to export machines to France and some other countries, but it does not seem as if our export trade in machines could be much to foreign countries after the war, unless our imports are considerable, for these nations will not be overburdened with money or credit, and probably will not consider it good financial operation to buy largely of foreign countries if, by any chance, they can supply their own needs.

R. E. Flanders

Manager Jones & Lamson Machine Company, Springfield, Vt.

We are inclined to think that we will find, for a time at least, that the United States will be over-supplied with machine plants at the close of the war. With this in mind, we have not felt justified in adding largely to our plant and equipment at this time. It is not probable that this over-building will be a permanent condition, but there is bound to be a considerable period of readjustment before the increased shop area can all be taken care of in normal business expansion.

In regard to your second question, would say that the writer has the same opinion about tools that he has about plants, namely, that we are liable to find ourselves for a time somewhat over-supplied. There is a difference, however, between a tool and a plant, namely, that the tools are getting extremely hard service, and will, many of them, be worth little or nothing after the war is over, particularly if it lasts for a considerable time longer.

The future of our export trade in machine tools will depend largely in the territory of the Allies on the permanence of the anti-German sentiment. There should be an excellent market for machine tools in these countries after the war; perhaps not immediately after, but after a period of adjustment has been gone through. In Germany itself there may be a considerable demand for a short time, but probably not a long continued demand.

As to other parts of the world, such as South America, China, etc., our exports of machine tools will depend almost entirely on the question of whether or not American bankers and moneyed men get into the habit of investing heavily in the industries, etc., of these countries. There is some evidence that this is going to take place, and to the extent that it does we may expect to get the machine tool trade of these countries. Otherwise, there is very little chance for us. The same reasoning applies to a considerable extent to Russia.

About the only improvement which the munitions work has shown is the necessity for an increased ruggedness and durability in our machine design. High speed steels and automobile piece work have been progressive factors in this development, but the munitions work has tended if anything to carry it a step further.

Charles E. Hildreth

Vice-President and Treasurer Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass.

I am strongly impressed by the strength of public sentiment for preparedness to feel that for some time, at least, the munition plants will be used for our own needs. After that they are so specially equipped I would not consider them as a whole any menace, but rather an asset for smaller powers requiring this nature of equipment.

Plans are now being worked out by some of our largest banking and allied interests to solve the question of export. We must also expect the hearty co-operation of our Government. In the meantime quite a number of our machine tool manufacturers are disregarding the war demands and are cultivating foreign business that

formerly was held by the warring nations, so that by the time the war is over they will be firmly intrenched.

I do not consider that munitions work has brought about any lasting improvements in shop equipment and methods, but rather the reverse. The entire enterprise has been too hurriedly promoted. The immediate demand has been too great. Its accomplishment has therefore introduced elements that are dangerous. In the first place, they took contracts at such prices that true values have been utterly disregarded. Machines were bought regardless of price, if only deliveries were made. Men were sought (?) and hired with an utter disregard to local or surrounding conditions of hours and wages.

As a result the machinists all over the country, through the spread of these facts, have been made dissatisfied with normal conditions to an extent that has been disturbing not only to the entire industry, but has extended to many others. When this abnormal business ceases it is difficult to see how the readjustment can be made back to normal conditions without almost a civil revolution. Our standard of living has risen so high in this country that with our present low tariff we shall be an easy prey to the nations now at war when they turn to civil life again, unless our statesmen are wise enough to read the handwriting on the wall.

Herbert H. Rice

President National Metal Trades Association, Indianapolis

It does seem to some manufacturers that the new plant buildings constructed with reference to the manufacture of war materials will not have any marked effect upon industries, as the mere existence of the buildings will not be sufficient inducement for the expansion of any industries unless there is an apparent need for such expansion.

The tools that have been purchased and put in use for the manufacture of munitions and for the production of munition making tools are restricted to comparatively few sizes and kinds of machine tools. When the need for these tools passes with the close of the war, there will of course be for a considerable time an excess supply of these particular tools, but the only result will be the ability to buy these special tools at lower prices. The special tools, if thrown on the market, cannot have very much effect on the general manufacturing industry, as they will represent but a small part of the equipment of factories for ordinary kinds of manufacture.

It is altogether probable that machine-tool builders and others who are now enjoying a good trade due to abnormal war conditions will be surprised to find at the close of the war how quickly their foreign competitors will recuperate and how rapidly export conditions will revert to the situation as it existed before the war.

I doubt if tool manufacturers think that their temporary advantage due to war conditions, and to the conditions that would prevail for a short time after the close of the war will give them any great permanent advantage in the world market. Indeed, it is a question whether with the renewal of activities in manufacturing plants abroad we shall not be confronted with stronger competition than ever before, and a more dangerous competition, due to the changed tariff condition which had hardly become effective when war was declared.

THE QUESTION OF HOURS AND WAGES

Munitions work is in its very nature abnormal and conducted mainly with the view to production with as much dispatch as possible and without very close attention to refinements in cost reduction, unless carried on for some considerable time. Generally speaking, the effect of this kind of work is demoralizing and far from tending to improve shop methods or equipment. Certainly, general lines of manufacture will receive little benefit from the extraordinary work done in filling war orders.

The chief difficulty will be the readjustment of wages and shop conditions to the normal state that will have to be resumed at the close of the war. Whether this readjustment will cause serious labor difficulties is something no one can predict. It is quite certain, however, that employees who have enjoyed extraordinary wages and unusual shop conditions will find it very difficult to come down to the lower wages and the entirely changed situation that will confront them when war jobs have ceased to exist.

It is particularly for this reason that the National Metal Trades Association has not ceased to call the attention of its members to the fact that the movement for the 8-hr. day in machine shop practice is one that cannot be looked upon with favor. President Johnson of the Machinists' Union is reported as advising against the acceptance of the 48-hr. week if it were divided into 8¾ hr. daily and a Saturday half holiday and recommended that the 8-hr. day maximum be insisted upon and then the Saturday half holiday should be demanded later. It is then really a 44-hr. week which is being asked for, because the Saturday half holiday is becoming very general, and properly so. It is impossible, I feel, for this country to prosper on a 44-hr. week in competition with what we may expect after the war. The statement frequently made that as much work can be produced in the 8-hr. day as in a longer day is in itself sufficiently answered by the fact that those people who are very busy continue to run overtime!

Wages have been considerably increased and this is as it should be with the demand and supply, but those firms who have increased wages without the thought of how wages will be reduced automatically when supply is greater than the demand and when competitive conditions have greatly changed, will find a dilemma from which they will extricate themselves with difficulty.

As to your particular question regarding the extent to which the 8-hr. day has been granted, I only need to call attention to the fact that in an attempt to prove it has been very generally granted the *Machinists' Journal* recently issued a list of only thirty-two firms, and mentioned in it some firms who are working on 8-hr. shifts. The number of machine shops that have changed to the 8-hr. day is very small indeed.

O. H. Broxterman

President John Steptoe Company, Cincinnati

You are proposing some very difficult questions, and at best we can only guess. We are all guessing, but at that I believe it is a good idea to get the different opinions of various manufacturers, assemble them and then something definite may be derived.

I would say that the most of the new munitions shops are going to continue to be machine shops, and are going to create competition for other plants in the machinery line. If business becomes good in this country before the discontinuing of the war, these plants will continue to be machine shops. If it does not become good in this country, and conditions in this country remain as they are at present, then a number of the shops will be dismantled and the second-hand machinery thrown on the market, as they will not be able to make any money and will therefore discontinue. A Republican administration under a high tariff, I believe, will enable them to continue, and I believe the war will not discontinue before the next election.

In Europe I find that a number of these manufacturers who have started up entirely for the purpose of manufacturing war supplies are, in some cases, looking around for other articles to manufacture. I

know this from the fact that a son of one of the manufacturers over there has asked me to suggest to him something that his father might manufacture after the war is ended.

I believe that immediately after the war there will be a slump in export trade. I do not think that they will buy anything for possibly two years. After that time I believe that it will again resume in better shape than ever before, due to the fact that England, France, Belgium, Spain, Italy and Russia will not again buy from Germany for at least the present generation, and consequently the American manufacturer of machine tools is going to get the advantage of that increased business. Previous to the war they were buying only a very small proportion from the United States, and Germany was getting by far the big end of the business. The business that was distributed among the German manufacturers from all of these countries will now come to the United States. I include Spain in that because I am advised by one of the dealers over there that now that he has used American machine tools he finds them so much better than the German ones that he will never again handle German tools.

I do not think that munition work has brought out any lasting improvements in machine shop methods, except possibly in the lathe line, where it has taught how to employ single purpose lathes for hogging off work, but in none of the other lines of machine tools has it made any change.

With regard to the shop conditions, the hours in the machine tool plants have not been changed very materially. The wages have become very high and that again will depend upon the condition of the trade in the United States after the war.

I believe that it will take a high tariff to make conditions improve in the United States, and if that occurs I believe that conditions will get very much better here and consequently the wages will hold their present level, but if conditions do not improve in the United States then there will be a very material cut in wages, as conditions as they exist now are abnormal. In many cases here in this city a war bonus is being paid which will undoubtedly be withdrawn.

Nicholas P. Lloyd

Newton Machine Tool Works, Inc., Philadelphia

A rather superficial opinion from a standpoint of the manufacturer of machine tools would be this: that we do not believe the market will be flooded with good used machinery, for the reason that much special purpose machinery, including lathes, has been developed and is being used for the manufacture of munitions.

This is particularly true in the manufacture of shells where the lathes and other tools receive extraordinarily hard usage, due to the continuous operation through 24 hr. per day by the crudest sort of operators—which means that the tools are first abused and secondly improperly repaired or maintained.

Again, a very extraordinary amount of used machinery has found its way out of this country, which is being replaced, of course, by new machinery. In our own case, we are renewing or replacing as much used machinery as we can, and hope to find at the expiration of a period that we have equipment which is superior to that which we had at the beginning of the rush period. However, we in common with many others are not purchasing any more than is absolutely necessary to balance the equipment which we have until the first rush is over, when we can secure new machines without paying a premium for them or waiting an indefinite period.

We believe that the standard manufacturers of tools will find an improved export trade, as we believe most of the manufacturers are doing as we are, exporting only A No. 1 equipment which will, as you know, create a good impression and give those machines a preference over similar tools manufactured in Europe.

We believe that the present conditions will bring about many lasting improvements and methods in shop equipment as is always the case in new quantity production development.

The unusual shop conditions we do not believe will outlast the war, as standard business will not permit of the excessively high wages now being paid for machinists, toolmakers and machine tool operators. As an illustration, we have not advanced our wages, but are paying a bonus which our men understand will be discontinued when the present period is past. This bonus is paid by a special card inserted in each pay envelope.

From conversations with many of the contractors for munitions we find that their general view is that when their contract is over much of the equipment that they have bought will find its way back into the cupola in the form of scrap.

A Central Western Manufacturer of Machine Tools

The questions you propound are very difficult ones. We would give many thousand dollars to know the correct answers. There seem to be two absolutely different schools of thought. Some maintain that there will be a great stagnation in business following the conclusion of the war, and the other school holds that for two or three years, at least, so great replacements will be necessary that the machine tool industry will be busy during that time.

We think the general condition of our country will have much to do with what the new munitions plants will do after the war. If, in the meantime, the country gets upon a thoroughly solid basis of business no doubt other work will be forthcoming for these new plants.

There have been unquestionably many hundreds, if not thousands, of lathes made that in normal times could not be sold on account of the poor workmanship. In addition, our positive information is to the effect that a great deal of ignorant labor has been used in the operation of lathes in the munitions work. For these two reasons a not inconsiderable proportion of these machines will, in our opinion, find their way into the cupola. The remainder in due course of time will be absorbed just as the over supply of machine tools in the automobile industry a few years ago was absorbed.

It may be taken for granted that the progressive machine tool manufacturers of the country have during this rush been carefully considering the future of their export trade and have been working out improvements which they will have ready to embody in tools after the rush is over, thereby still maintaining their lead over many of their foreign competitors.

We believe that wages will never recede to even the high point they had reached previous to the war, but unquestionably they will recede from the present point. During the last fifteen months many thousands of men have gone into the machine shops of the country as green men; out of these unquestionably some will develop into good workmen and will remain in the business. The result on prices of an over-supply is always a tendency to lower the price.

An Eastern Manufacturer of Machinery

We are inclined to believe that there will have to be a readjustment in labor conditions as well as in the conditions of increased tool equipment and shop area. The present conditions are abnormal. Many of the workmen who have left 9-hr. shops for 8-hr. shops and increased pay will find themselves out of work, and some of them at least will be glad to go back to work under the old conditions.

What May the Iron and Steel Trades Expect When Peace Is Declared in Europe?

(*Continued from Page 30*)

necessities of the countries now at war will be found absolutely necessary. Where else should they come except to this, the greatest market in the world, where their money and the money of all the other warring nations has been poured out during the period of war?

My experience is that the hardest man to compete with as to price values is the impecunious man. The hardest firm or corporation to compete with is one that is not doing a profitable business, or in a flourishing condition. I can conceive that the same thing will be true of nations, and that the European nations, being enormously burdened with debts, if not practically bankrupt, will make prices both in order to put their people to work and in order to get money back into their countries that no nation can successfully compete with and maintain a standard of wages or of living consistent with decent prosperity. Therefore, I am of the opinion that unless our tariff laws as applied to Schedule C are materially revised upward so as to preserve the American market to the American laborer and the American producer, we shall find our market seriously invaded by cheap European products that will destroy American prosperity so long as such importation is continued. If adequate protection is given to American industries, I can easily conceive that we should experience a period of not less than three years and perhaps many years more of great prosperity; and it must be borne in mind that neither prosperity nor depression can fail to affect both the poor man and the rich man. We cannot hurt the one without hurting the other, nor can we benefit the one without benefiting the other.

I am of the opinion that immediate cessation of the war would bring forth a balancing of corners to find where we all stand. With the present tariff it would cause depression. With reasonable protection our prosperity could not be destroyed for some time at least.

EMPHASIS ON LABOR AND THE TARIFF

WILLIAM A. ROGERS, PRESIDENT ROGERS-BROWN IRON COMPANY, BUFFALO, N. Y.

I feel quite certain our prosperity will outlast the war. It is likely that a sudden cessation would cause hesitation in business until men could take account of events likely to happen, and shape their course accordingly. This country, however, has embarked upon a period of replacement of wear and tear and of expansion which for two or three years is likely to be checked only by its own acts or lack of action.

One cannot safely forecast the effect of the war's ending on labor conditions at home and in Europe. The slaughter and maiming of so many able bodied men must necessarily throw a heavier burden of manual labor than ever on the women of Europe. They will probably take their place in greater numbers than ever in the fields and workshops of the continent. It is also natural to suppose that a great number of men and families will be anxious to get away from the possibilities of being again called to such sacrifice and from the burden of taxation which will afflict those people for years. On the other hand governments are likely to raise obstacles to the departure of their already depleted manhood to such an extent that emigration from Europe may be less than heretofore. Industrially speaking it would be to the advantage of this country to have a strong tide of able men and women set this way. Without them we may expect to develop less rapidly than our possibilities.

As to exports of iron and steel, we have started new streams flowing abroad and it would be natural to expect them to go on with greater volume, but they can be so easily dried up by high cost of labor here and the hungry competition of Europe, that here again it is difficult to forecast.

The most pressing need in the way of legislation is a revision of the present tariff. Just before the breaking out of this war a great tidal wave of foreign-made commodities had started toward our shores, threatening to engulf great numbers of our industries, and had not these imports been stopped by hostilities we would have had one of the most serious business disturbances this country had ever experienced. The way is still open and unless we meanwhile protect ourselves we can expect such a condition to prevail just as soon as the manufacturing countries of Europe can put themselves in position to send their goods our way.

The second legislative need is to remove from our statute books laws which have made it unprofitable to operate ocean ships under the American flag. We can have no merchant marine of our own for oversea traffic until our people can be assured of an uninterrupted chance to operate their ships on the same basis as the rest of the world.

For 1916 I think we shall need all the iron and steel capacity which the country now possesses.

FUTURE DEPENDS ON CHARACTER OF LEGISLATION

R. H. SWEETSER, PRESIDENT THOMAS IRON COMPANY, EASTON, PA.

1. Will our prosperity outlast the war? Yes, if we have our industries protected by a protective tariff.

2. How will immigration and labor conditions at home and in Europe be affected by the war's ending? I think there will be work for everybody.

3. I believe that our export trade will steadily increase, but it will take several years of missionary work and constructive effort before we get the full benefit.

4. There should be a complete reversal of the method for obtaining revenue for the expenses of the Government. A protective tariff would have prevented the necessity for the so-called "war tax" and a protective tariff would have prevented considerable of the great depression we have just passed through. I left Canada in November, 1907, where the Government was paying a bonus to blast-furnace men on pig iron made from Canadian ores, and I returned to the United States in time to get the full benefit of the depression that began in the fall of 1907. Our Administration now proposes to *make the blast-furnace men pay a tax* for the privilege of making pig iron, and will allow the foreign pig-iron maker to send his pig iron to this country free of such taxes.

5. The indications at present are most promising for the iron and steel business in 1916. The natural increase in demand for iron and steel will take care of

the several additions to the steel making capacity that are now under way. The change in attitude of the Administration and the public in general towards big business enterprises and the high character of the big business concerns of this country make it possible and very probable that large enterprises in transportation and in manufacturing will be planned and constructed in the near future.

EUROPE WILL SEEK QUICK REBUILDING OF EXPORTS

WILLIS L. KING, VICE-PRESIDENT JONES & LAUGHLIN STEEL COMPANY, PITTSBURGH

In my opinion, when the war has come to an end, the countries of Europe, and especially Germany, will turn their attention first to the re-establishment and expansion of their export trade, on account of the lack of capital at home for public and private improvements. If our present tariff law is still in effect, they will commence to dump manufactured goods of all kinds into this country, with small regard for cost, and under such conditions our prosperity will not long outlast the war. Labor will be low in the countries of Europe, and immigration will doubtless be prohibited by the various governments, for a time at least.

We have made a good start in our export trade, but it will be hard for us to retain it under the conditions above outlined. During the continuance of the war, this country will be favored with a business exceeding all previous records, and as there seems to be no sign of an early termination of the war, I believe that even with the additional steel making facilties, our capacity will be taxed to the utmost during the year 1916, and perhaps several years longer, provided that an adequate tariff law is passed.

The war has created a protection to American industries and workmen denied to us by the Wilson-Underwood tariff, and we should not deceive ourselves as to the cause of our prosperity nor as to the change in conditions bound to come when the present law again becomes effective.

In closing, I desire to congratulate THE IRON AGE on the completion of its sixtieth year in business. It has built up a great commercial and industrial periodical, and there is a good reason both for its age and influence.

A PROSPEROUS YEAR AHEAD, WITH TROUBLE LATER

A. F. HUSTON, PRESIDENT LUKENS IRON & STEEL COMPANY, COATESVILLE, PA.

It is true, as you state, there are opposite views of the effect of the ending of the war on our steel industry. It does seem to me likely when this comes that we shall have a drop in business for a time, but it looks as though it would shortly recover and go on in considerable volume. There are many who think there will be no drop. Of course, the business has accumulated so great a momentum at this time that we should all welcome a respite and should be able to run many weeks or months without taking on more business or changing prices. I very much fear we shall have a shortage of labor this coming year and that at the end of the war the countries across the Atlantic will put an embargo on emigration. And one thing is certain, we must have a protective tariff before that time or we shall be in dire straits. The Philadelphia *Ledger* said in its leading editorial a few weeks since that unless we have a change of administration and Congress as the result of next year's election we shall see the worst times our country has ever experienced, for the warring countries will need to rehabilitate their industries and ship to those countries having gold to pay.

I quite agree that a protective tariff is vital. There has been too much quibbling, and effort to make out that an iniquitous measure like the LaFollette shipping bill is all right. This more than one has done, and we are in crying need of legislation to make it possible to build up our merchant marine.

This coming year is bound to be unprecedentedly prosperous to us all, at least so long as the war lasts, and prices are soaring so high in some lines as to cause serious concern.

CONTINUED PROSPERITY PREDICTED—POSSIBLE LABOR SCARCITY

GEORGE M. VERITY, PRESIDENT AMERICAN ROLLING MILL COMPANY, MIDDLETOWN, OHIO.

One only needs to sift the facts concerning current events to find many substantial reasons for the growing belief that good business will last at least from three to five years after peace, and possibly much longer, unless over-speculation brings about an earlier reaction. Business will receive a tremendous impetus through the fact that the American farmer is certain to secure the benefit of at least three crops at war prices. The yearly value of the farm products of the United States, not including live stock, is now running at the rate of at least $5,600,000,000. The railroads, our largest consumers of iron and steel and of many other products, are just entering a period of more active buying. It now seems practically certain that for the current calendar year our foreign trade balance will reach the enormous sum of $2,000,000,000. This great balance, together with our rapidly increasing wealth from all sources, makes it evident that we will have the means which no other nation will have with which to stimulate and build up world trade, and thus increase the buying power of non-producing nations that must trade with us.

Business will be accelerated through the fact that the surplus producing capacity of our country will be needed in the physical rebuilding of Europe. Commissioners from France are now in our midst and have advised us that they will want to purchase many millions of dollars worth of American machine tools and machinery of all kinds to enable them not only to rebuild that which has been destroyed, but to rejuvenate and bring up to date every industry. For many years to come the demands of rehabilitation and reconstruction in Europe should be equal to or greater than those of war.

There are many who do not believe that the coming of peace in Europe will bring still cheaper labor to compete with the increasing high cost of labor at home. When the factories and mills of France, Germany, Belgium and Russia are rebuilt and re-equipped and these industries, together with those of England, again light their fires and their whistles blow the call to work, millions there have been who will never answer that call again. How can such a scarcity of competent labor result in other than a substantial increase in compen-

sation to those who are able to respond? That labor in Europe, skilled labor at least, should reach a point more in harmony with that paid in our own country is not inconceivable. However, I admit that there is room for difference of opinion, and that the events of the day are so momentous as to make it impossible to foretell the exact direction in which economic laws will work when peace is restored.

The supply of common labor in America has been decreased by the calling home of reserves of the foreign nations at war. It seems reasonable to believe that Europe will not permit any great amount of emigration to this country after the war, with so great a need and so short a supply available at home. If that should be the case there is bound to be a great shortage of common labor, which could well be serious enough to retard our industrial progress.

If the United States desires to be in position to take advantage of world-wide changing conditions, and of the opportunities they may bring to us, we should have the protection of national legislation so sound, so flexible, so fair and so assuring to both capital and labor that it would not be possible to make America a dumping ground for any nation under any conditions.

CHAIRMAN GARY CONSIDERS LEGISLATIVE FACTOR IMPORTANT

Elbert H. Gary, chairman of the United States Steel Corporation, makes categorical answers to THE IRON AGE's inquiries as follows:

Q. Will our prosperity outlast the war?

A. Yes, for a time at least. The length depends largely upon the attitude of our Government and the law makers toward business.

Q. How will immigration and labor conditions at home and in Europe be affected by the war's ending?

A. I think we shall have a good deal of immigration following the war. There is a possibility of labor troubles abroad and these may affect conditions here somewhat.

Q. What is the future of our export trade

A. We may expect greater competition than ever. Our exports should increase. We need a merchant marine and a strong navy.

Q. What legislation at Washington, if any, is called for in view of the changes that are coming?

A. Tariff laws that furnish adequate protection to producers including the workmen.

Q. What are the signs for 1916 in iron and steel? Will the large additions to steel-making capacity that are coming on in every direction leave us with more than we shall need?

A. (a) Big business for the first six months of 1916 at least. (b) This seems possible and perhaps probable.

BASIS ON WHICH PROSPERITY WILL LAST—LABOR COST ABROAD

E. A. S. CLARKE, PRESIDENT LACKAWANNA STEEL COMPANY

Replying to your letter of Dec. 15, I have given careful thought to your statement and the questions you ask, and beg to reply as follows:

1. Will our prosperity outlast the war?

This is the most difficult of all your questions to answer satisfactorily. With the great accumulation of money in this country, prosperity should continue, though it may have a temporary halt when the war ends. It will depend, further, largely on the attitude of our legislators and upon the attitude the various foreign nations take in regard to our world activities. I believe that as a nation we must increase our foreign trade, as our home markets will never be able to absorb out entire producing capacity. To do this we shall have to use a portion of our capital for the financing of undeveloped foreign countries; but we should be able to do this and also continue the normal development of our own resources. The outcome will depend upon an intelligent policy which will enable us to develop our export trade without unfriendly attack from foreign nations, and also a policy which will permit of the development of our own resources on a sound basis that will insure a reasonable return to capital. Given such a national policy, our prosperity should continue after the end of the European war.

2. How will immigration and labor conditions at home and in Europe be affected by the war's ending?

One view is that there will be such a demand for labor in the belligerent countries for rehabilitation, that emigration to this country will be very small for a number of years. Another view is that conditions will be so difficult in the belligerent countries after the war that many will prefer to come to this country, believing that a given amount of effort will produce quicker and more lasting results here than at home. If the foreign peoples do not come to this country, we will see a shortage of labor, with high wages and labor costs; but the demand for labor in the belligerent countries will be so great that their labor costs will also probably be raised more nearly to a level with ours. Should the people of those countries come in large numbers to this side, wages, owing to the increased supply of men, will be lower and costs of labor lower. But in this event the shortage of men in the belligerent countries will increase labor costs over there so as to bring them more nearly to a parity with ours. It therefore seems to me that, whatever the outcome, labor costs in Europe and in this country after the war will be more nearly on a parity than heretofore.

3. What is the future of our export trade in iron and steel?

If the country as a whole is to increase its foreign trade, iron and steel must increase with it. In general, the volume of out export business in iron and steel will be measured by the extent to which we can compete on an even basis as to price and quality with other nations. It is my belief that we can do this provided we have adequate banking and transportation facilities at our command.

4. What legislation at Washington, if any, is called for in view of the changes that are coming?

I have already referred to this in my answer to question No. 1. In addition to the matters mentioned in general there, we should have such tariff protection —particularly against dumping by foreign nations—as will prevent their flooding us with material shipped at or below cost, in order to dispose of their surplus. In this way, we can at least maintain a fair basis of prices at home, though, of course, the result may be to make competition in neutral markets severe.

5. What are the signs for 1916 in iron and steel? Will the large additions to steel-making capacity that are coming on in every direction leave us with more than we shall need?

As regards 1916, I believe that our prosperity will continue, and that the country will absorb all the increased capacity now projected; but it is not likely that the country will regularly absorb all of this increase. Experience shows that in times of great prosperity we have almost always increased our capacity beyond normal needs, with the unfortunate result that when demand slackens the excess capacity causes an unreasonable competition, which results in unreasonably low prices.

The Electric Steel Industry's Present Status

United States Now Leads All Other Countries—A Review of Progress Since 1910—303 Furnaces in the World's Steel Industry

The United States now leads the world in electric steel. A year ago Germany was first. Progress in this increasingly important industry in 1915 has been remarkable, especially in our own country and Canada. On Jan. 1, 1915, the review of THE IRON AGE, published Jan. 7, 1915, showed 41 electric furnaces operating or contracted for in this country and 2 in Canada. At the opening of 1916 the total had increased to 73 in the United States and 8 in Canada, or 81 in both countries, an increase of 38 or over 88 per cent.

When THE IRON AGE of Apr. 14, 1910, first published a list of electric furnace installations in the world as printed by *Stahl und Eisen*, it showed a total of 114. In its issue of July 1, 1913, when this present review was initiated, the world's total was 140. A year ago, Jan. 1, 1915, our review showed that this total had advanced to 213. Despite the war, or rather in some cases because of it, the present review of 1916 shows 303 electric furnaces in the world's steel industry against 213 Jan. 1, 1915, a gain of 90 furnaces or 42.3 per cent, by far the greatest part of which has been in the United States.

The following tables are somewhat different from those published by THE IRON AGE, Jan. 7, 1915. Then all the known furnaces in the world, with the location of nearly all, were tabulated. In this review tables are given of the location of each type of furnace in the United States and Canada, while one table is devoted to additional furnaces in Europe installed in 1915, thus supplementing the data of a year ago. Tables 1, 2, 3 and 4 give respectively the Heroult, Snyder, Wile and miscellaneous furnaces operating or contracted for in the United States and Canada on Jan. 1, 1916. Table 5 gives the furnaces of various types installed or contracted for in Europe during 1915. The Rennerfelt European installations, not having been given a year ago, are included in Table 6. Miscellaneous furnaces in Europe of special type are found in Table 7. Any difference between these tables and those of a year ago are due to certain furnaces having been discontinued. A recapitulation of the world's furnaces is given in Table 8.

Table 1—Heroult Electric Steel Furnaces Operating or Contracted for in the United States and Canada, Jan. 1, 1916

Company	Location	Size, Tons	Current Phase	Charge	Product
UNITED STATES:					
Halcomb Steel Company	Syracuse, N. Y.	4	Single	Basic open-hearth metal	Special and tool steel
Halcomb Steel Company	Syracuse, N. Y.	6*	Three	Cold scrap	Special and tool steel
Firth Sterling Steel Company	McKeesport, Pa.	3	Three	Cold scrap	Special and tool steel
Illinois Steel Company	So. Chicago, Ill.	15	Three	Bessemer and B. O. H. M.	Special and rail steel
Illinois Steel Company	Joliet, Ill.	4	Three	Ferromanganese	Molten ferromanganese
American Steel & Wire Company	Worcester, Mass.	15	Three	Basic open-hearth metal	Wire steel
General Electric Company	Schenectady, N. Y.	5	Three	Cold scrap	Castings
General Electric Company	Schenectady, N. Y.	3	Three	Cold scrap	Castings
General Electric Company	Schenectady, N. Y.	3	Three	Cold scrap	Castings
Treadwell Engineering Company	Easton, Pa.	2	Three	Cold scrap	Castings
National Malleable Castings Company	Sharon, Pa.	6	Three	Cold scrap and B. O. H. M.	Castings
National Malleable Castings Company	Sharon, Pa.	6	Three	Cold scrap and B. O. H. M.	Castings
National Malleable Castings Company	Chicago, Ill.	6	Three	Bessemer metal, cupola metal and cold scrap	Castings, steel and malleable
National Malleable Castings Company	Chicago, Ill.	6*	Three	Bessemer metal, cupola metal and cold scrap	Castings, steel and malleable
National Malleable Castings Company	Chicago, Ill.	6*	Three	Bessemer metal, cupola metal and cold scrap	Castings, steel and malleable
Crucible Steel Company of America	Harrison, N. J.	6	Three	Basic O.H.M. and cold scrap	Special steels
Buchanan Electric Steel Company	Buchanan, Mich.	3	Three	Cold scrap	Castings
Buchanan Electric Steel Company	Buchanan, Mich.	2	Three	Cold scrap	Castings
Latrobe Electric Steel Company	Latrobe, Pa.	6	Three	Cold scrap	Special and tool steel
Latrobe Electric Steel Company	Latrobe, Pa.	3	Three	Cold scrap	Special and tool steel
United Steel Company	Canton, Ohio	6	Three	Cold scrap	Special steel
United Steel Company	Canton, Ohio	15	Three	Cold scrap	Special steel
Lebanon Steel Foundry	Lebanon, Pa.	1	Three	Cold scrap	Castings
Electric Steel Company of Indiana	Indianapolis, Ind.	3	Three	Cold scrap	Castings
American Steel Foundries Company	Indiana Harbor, Ind.	6	Three	Cold scrap	Castings
Michigan Steel Castings Company	Detroit, Mich.	6	Three	Cold scrap	Castings
Michigan Steel Castings Company	Detroit, Mich.	3	Three	Cold scrap	Castings
Belle City Malleable Iron Company	Racine, Wis.	3*	Three	Cold scrap	Castings
Buckeye Steel Castings Company	Columbus, Ohio	6*	Three	Cold scrap and B. O. H. M.	Castings
Simonds Manufacturing Company	Lockport, N. Y.	6*	Three	Cold scrap	Saw, tool and special stee
Hess Steel Corporation	Baltimore, Md.	6*	Three	Cold scrap	Special steels
Universal Rolling Mill Company	Bridgeville, Pa.	6*	Three	Cold scrap	Saw, tool and special steel
Carbon Steel Company	Pittsburgh, Pa.	6*	Three	Cold scrap	Special and alloy steels
Braeburn Steel Company	Braeburn, Pa.	6*	Three	Cold scrap	Special alloy and tool steels
Crucible Steel Casting Company	Cleveland, Ohio	1*	Three	Cold scrap	Steel castings
Monarch Foundry Company	Stockton, Cal.	1*	Three	Cold scrap	Steel castings
Harrow Spring Company	Kalamazoo, Mich.	6*	Three	Cold scrap	Special and alloy steels
Union Spring and Mfg. Company	New Kensington, Pa.	6*	Three	Cold scrap	Castings
International High Speed Steel Company	Rockaway, N. J.	6*	Three	Cold scrap	Special and tool steels
Alabama Power Company	Anniston, Ala.	6*	Three	Cold scrap	War material
CANADA:					
Electric Steel & Metals, Ltd.	Welland, Ont.	6	Three	Cold scrap	War material
Electric Steel & Metals, Ltd.	Welland, Ont.	6*	Three	Cold scrap	War material
Armstrong, Whitworth of Canada	Longueuil, Que.	3*	Three	Cold scrap	Tool steel

Total in the United States: Operating, 24; contracted for, 16=40.
Total in Canada: Operating, 1; contracted for, 2=3.

*Contracted for; rest all operating. All these furnaces are basic.

The total production per year of the 40 Heroult furnaces in the United States is placed at 1,470,350 tons and the 3 in Canada at 21,600 tons, making a total for the United States and Canada of 1,491,950 tons.

The average size of the 24 Heroult furnaces operating in the United States is 5.9 tons and that of the 16 contracted for is 4.1 tons. In Canada 6 tons represents the average operating size, while 4.5 tons the average of those contracted for.

Table 2—Snyder Electric Steel Furnaces Operating or Contracted for in the United States and Canada, Jan. 1, 1916

Company	Location	Daily Capacity in 24 Hrs., Tons	Product
Crucible Steel Castings Company	Milwaukee, Wis.	12	Steel castings
Otis Elevator Company	Buffalo, N. Y.	30	Steel castings
Otis Elevator Company	Buffalo, N. Y.	30	Steel castings
Niagara Electric Steel Corporation	North Tonawanda, N. Y.	6	Steel castings
Gerlinger Steel Casting Company	Milwaukee, Wis.	6	Steel castings
Dayton Steel Foundry Company	Dayton, Ohio	6	Steel castings
S. Fair & Sons, Inc.	Saginaw, Mich.	6	Steel castings
Halcomb Steel Company	Syracuse, N. Y.	30	Special steels
Sivyer Steel Casting Company	Milwaukee, Wis.	12	Steel castings
Electric Steel Company	Chicago, Ill.	12	Steel castings
Haynes Stellite Company	Kokomo, Ind.	1½	Special alloys
Snyder Electric Furnace Company	Chicago, Ill.	6	Experimental
Thomas Davidson Mfg. Company	Montreal, Que.	12	War munitions
Canadian Brake Shoe Company	Sherbrooke, Que.	20	War munitions

Total in the United States, 12; in Canada, 2=14.

A steel-melting furnace and one for another purpose is to be sent to Chile.
Four furnaces for smelting ferrosilicon are being installed.
One Snyder furnace is now operating melting brass at the plant of the Chicago Metal Bearing Company.
About seven Snyder furnaces are operating on special chemical work of a confidential nature.

PROGRESS IN THE UNITED STATES IN 1915

The year 1915 has witnessed an increase of 78 per cent in electric steel furnace development in the United States or from 41 furnaces on Jan. 1, 1915, to 73 on Jan. 1, 1916. Taking this country and Canada together the increase has been 88 per cent.

The outstanding feature has been the growth in the number of Heroult furnace installations in the past year. On Jan. 1, 1915, there were only 19 furnaces of this type in the United States and Canada but now there are 43 or more than double a year ago. While the steel casting industry has claimed the greater part of these, the tool steel and special steel industry are adopting this refining medium to a growing degree.

The Snyder furnace has made rapid strides, the total now being 14 in this country and Canada against 7 a year ago. As stated in the tables, it is also being introduced in brass melting, in silicon smelting and in the chemical industry.

The Wile furnace is a new entrant into this industry within the year. Seven furnaces are already introduced in this country and Canada. This type was described in THE IRON AGE, Oct. 14, 1915.

The Rennerfelt furnace, though not a competitor in the American field until late in 1915, already has 2 installations contracted for with bright prospects reported for a splendid record in 1916. The success of this Swedish furnace in Europe has been rather remarkable in the past two years. In Sweden there are four of these furnaces in the brass industry and one in the chemical besides the 33 in the steel industry of Europe—described in THE IRON AGE, Jan. 15, 1914.

The Crafts furnace of special induction type and described in THE IRON AGE, Sept. 18, 1913, is understood to have been very recently put in operation in this country besides the one Grönwall unit.

Table 3—Wile Electric Steel Furnaces Operating or Contracted for in the United States and Canada, Jan. 1, 1916

Company	Location	Size, Tons	Charge	Product	Daily Capacity in 24 Hr., Tons
Westinghouse Elec. & Mfg. Company	East Pittsburgh, Pa.	1	Cold stock	Steel castings	12
Copper Clad Steel Company	Rankin, Pa.	1.5	Cold stock	Steel castings	15
Pittsburgh Steel Company	Monessen, Pa.	1.5	Ferro-manganese	Molten ferro-manganese	15
Carbon Steel Company	Pittsburgh, Pa.	1	Ferrochrome	Molten ferro-chrome	12
Damascus Crucible Steel Company	New Brighton, Pa.	0.5	Cold stock	Steel castings	6
Jones & Laughlin Steel Company	Aliquippa, Pa.	1	Tin dross	Steel castings	12
W. A. Mackay	St. Johns, Newfoundland	1.5	Raw stock	Slabs	15

Total in the United States, 6; in Canada, 1=7.

All furnaces are 3-phase.

The two large 20-ton induction furnaces at the plant of the American Iron & Steel Mfg. Company, Lebanon, Pa., are completely installed and will probably be in full operation sometime this year. This is still the largest electric steel plant in the United States.

The apparent net increase of 32 furnaces in the year is really less than the actual, since at least 6, reported last year, were dropped during the year.

DEVELOPMENTS IN EUROPE

Progress in Europe in 1915 has been definitely determined by the war, in some cases creating such a demand for special castings and shell steel that this has acted as a decided stimulus to electric furnace activity.

In England the greatest development in this line has appeared. On Jan. 1, 1915, there were only 16 furnaces credited to that country; in the past year these have increased to 46. Here again the Heroult furnace has placed the principal rôle. Of the 1915 increase of 28 furnaces in England, 15 of these are

Table 4—Electric Steel Furnaces, Operating or Contracted for in the United States and Canada, Jan. 1, 1916, Other than Heroult, Snyder and Wile

Company	Location	Charge	Power, Kw.	Product	Furnace
Old Dominion Iron & Nail Works Company	Richmond, Va.	9000 lb.	750	Ingot steel from cold scrap	Rennerfelt
Old Dominion Iron & Nail Works Company	Richmond, Va.	9000 lb.	750	Ingot steel from cold scrap	Rennerfelt
		Tons	Phase		
Washington Steel & Ordnance Company	Washington, D. C.	1.4	Three	Steel castings	Stassano
Warren Steel Castings Company	St. Louis, Mo.	1	Three	Steel castings	Stassano
Warman Steel Castings Company	Redondo Beach, Cal.	1	Three	Steel castings	Stassano
The John A. Crowley Company	Detroit, Mich.	6	Two	Steel castings	Grönwal
Simonds Mfg. Company	Lockport, N. Y.	2	Single	Special ingots	Girod
Bethlehem Steel Company	So. Bethlehem, Pa.	10	....	Special steel	Girod
Washington Iron Works	Seattle, Wash.	3	....	Steel castings	Girod
Electric Steel Foundry	Portland, Ore.	1	....	Steel castings	Girod
Moffat Irving Steel Works, Ltd.	Toronto, Ont.	1.1	Three	Steel castings	Special
Tivani Electric Steel Company	Belleville, Ont.	3	Two	Tool steel and castings	Special
Ludlum Steel & Spring Company	Watervliet, N. Y.	2.1	....	Tool steel	Special

Total in the United States and Canada: Rennerfelt, 2; Stassano, 3; Grönwall, 1 Girod, 4; Special, 3=11.

Heroult, 10 Grinwall, 3 Snyder, 1 Induction and 1 Rennerfelt, the apparent discrepancy being due to the dropping of furnaces or changes in the original plans of a year ago.

In France, 3 Heroult furnaces have been added in 1915 and 1 Rennerfelt. The growth in Russia has been from 9 to 11, two Rennerfelt furnaces having been installed. In Sweden the total has jumped from 18 to 23 and in Norway from 2 to 6 in 1915, due to the rapid growth in popularity of the Rennerfelt furnace.

Developments in Germany and Austria are uncertain. The war has interfered with obtaining full information. While the production of electric steel in Germany has increased very decidedly it is due either to a speeding up of the productive power of the existing furnaces or possibly to the seven new installations. A year ago our record showed 46 furnaces in Germany; this year the total is 53. The number in Austria remains unchanged. In Germany there have been 8 new induction and 5 old ones abandoned or altered, making a net gain of 3, which with 2 new Keller and 2 new Nathusius furnaces makes an increase of 7.

In the increase in the introduction of furnace types the Heroult leads. On Jan. 1, 1915, there were 56 Heroult furnaces in Europe; now there are 72. A year ago there were 18 Rennerfelts across the seas and

Table 5—Electric Steel Furnaces Installed or Contracted for in Europe in 1915, Being Additional to Those Given in THE IRON AGE, *Jan. 7, 1915*

Company	Location	Country	Size in Tons	Phase	Charge	Product	Type
Vickers, Son & Maxim, Ltd.	Sheffield	England	10	Three	Cold scrap	Tool steel and war material	Heroult
Vickers, Son & Maxim, Ltd.	Sheffield	England	10	Three	Cold scrap	Tool steel and war material	Heroult
Thomas Firth & Sons	Sheffield	England	4	Single	Cold scrap, etc.	Tool steel	Heroult
Thomas Firth & Sons	Sheffield	England	6	Three	Cold scrap, etc.	Tool steel	Heroult
Hadfields, Ltd.	Sheffield	England	3	Three	Cold scrap	Castings and war material	Heroult
Hadfields, Ltd.	Sheffield	England	6	Three	Cold scrap	Castings and war material	Heroult
Hadfields, Ltd.	Sheffield	England	6	Three	Cold scrap	Castings and war material	Heroult
Hadfields, Ltd.	Sheffield	England	6	Three	Cold scrap	Castings and war material	Heroult
Hadfields, Ltd.	Sheffield	England	6	Three	Cold scrap	Castings and war material	Heroult
Samuel Osborn & Co., Ltd.	Sheffield	England	3	Three	Cold scrap	Tool steel	Heroult
John Brown & Co., Ltd.	Sheffield	England	3	Three	Cold scrap	Tool steel	Heroult
John Brown & Co., Ltd.	Sheffield	England	6	Three	Cold scrap	Tool steel	Heroult
Brown Bayley	Sheffield	England	6	Three	Bessemer metal	War material	Heroult
Seebohm & Dieckstahl	Sheffield	England	3	Three	Cold scrap	Tool steel	Heroult
London Foundry Company	Brimsdown	England	3	Three	Cold scrap	Castings	Heroult
Societe Electrometallurgique Francaise	Le Praz	France	3	Single	Cold scrap	Tool steel	Heroult
Acieres Electrique du Chambon	Le Chambon	France	6	Single	Cold scrap	Tool steel	Heroult
J. J. Carnaud et Foyes de Basse Indes	Basse Indes	France	3	Single	Cold scrap	Castings	Heroult
Sheffield University	Sheffield	England	0.3	Single	Cold scrap		Kjellin
Bergische Stahlindustrie	Remschied	Germany	5	Single	Liquid O-H.		Roechling-Rodenhauser
Stahlwerk Becker	Willich	Germany	8	Three	Liquid O-H.		Roechling-Rodenhauser
Stahlwerk Becker	Willich	Germany	8	Three	Liquid O-H.		Roechling-Rodenhauser
Stahlwerk Becker	Willich	Germany	8	Three	Liquid O-H.		Roechling-Rodenhauser
Roechlingsche Eisen & Stahlwerke	Volkingen	Germany	4	Three	Liquid basic Bessemer		Roechling-Rodenhauser
Reinische Stahlwerke	Duisberg-Meidnich	Germany	2				Roechling-Rodenhauser
Norsk Hydro Elektrisk Kvaefstotaktieselskab	Kristiania	Norway	1	Single	Cold scrap		Roechling-Rodenhauser
Rombacher Huttenwerke	Rombach	Germany	3	Three		Molten Ferromanganese	Rombach-Schemman und Bronn
F. L. Asgeness	Kristiania	Norway	1.5	Three	Cold scrap		Wile
Daimler Motor Company		England	3 per 24 hr.	Three			Snyder
Summerson & Son, Ltd.		England	12 per 24 hr.	Three			Snyder
Thwaites Brothers, Ltd.		England	12 per 24 hr.	Three			Snyder

Total: Heroult, 18; Induction, 8; Rombacher, 1; Wile, 1; Snyder, 3=31.

Table 6—Rennerfelt Electric Steel Furnaces Operating or Contracted for in Europe Jan. 1, 1916

Company and Location	Country	Charge, Lb.	Power, Kw.	Product
Hultfabricks, Hallstahammer	Sweden	600	80	Steel castings and tool steel
Bultfabricks, Hallstahammer	Sweden	600	80	Steel castings and tool steel
Bultfabricks, Hallstahammer	Sweden	2500	200	Steel castings and tool steel
Bultfabricks, Hallstahammer	Sweden	2500	200	Steel castings and tool steel
Stridsberg & Biörck, Trollhättan	Sweden	1200	120	Tool steel
Ljusne-Woxna, Ljusne	Sweden	1200	150	Steel casting
Ljusne-Woxna, Ljusne	Sweden	6000	350	Electro steel and steel from pig iron and ore
Ljusne-Woxna, Ljusne	Sweden	2500	200	Electro steel and steel from pig iron
Wirbso Bruk, Wirbso	Sweden	1200	125	Steel and iron castings
Åbjorn Andersson Mek Verkstads, Svedala	Sweden	1200	125	Steel castings
Sandvikens Jernverks, Sandviken	Sweden	1800	175	Electro steel and iron
Söderhamns Nya Verkst, Söderhamn	Sweden	1200	150	Steel castings
Svenska Metallverken, Västeras	Sweden	600	75	Brass melting
F. Hultgren, Stockholm	Sweden	200	50	Chemical purposes
Elektriska Stäljutiriet, Gäfle	Sweden	2500	200	Steel castings
Elektriska Stäljutiriet, Gäfle	Sweden	2500	200	Steel castings
O/Y Locomo, Tammerfors	Sweden	2500	200	Steel castings
Allmänna Svenska Electriska, Västeras	Sweden	600	75	Brass melting
Luth & Roséns Electriska, Stockholm	Sweden	600	75	Brass melting
Stannum, Stockholm	Sweden	300	50	Brass melting
Kockum Jernverks, Kallinge	Sweden	2500	200	Steel castings
Kockum Jernverks, Kallinge	Sweden	2500	200	Steel castings
Kolswa Jernverks, Kolswa	Sweden	2500	200	Steel castings
Oesterby Bruk, Dannemora	Sweden	1200	125	Tool steel
Nordiska Amatur fabriks, Atvidaberg	Sweden	800	75	Brass and copper melting
Drammens Jernstöberi & Mek Verksted, Drammen	Norway	1200	125	Steel castings
Arendal Smeltverk, Kristiania	Norway	1200	150	
Tyssefaldene, Kristiania	Norway	1200		
Automobile Works of the Imperial Russian Army, Petrograd	Russia	600	80	Steel castings
Maschinenfabrik Luding Nobel, Petrograd	Russia	5000	250	Special steel from hot metal
Baron Alfthan, Petrograd	Russia	1200	150	Steel castings
Russian Arsenal, Petrograd	Russia	2500	200	Electro steel
Etablissement Sautter-Harlé, Paris	France	600	75	Steel castings
L'Industrie Electrique & Mecanique, Geneva	Switzerland	600	75	Steel castings
Edgar Allen & Co., Ltd., Sheffield	England	2500	200	Steel castings
A. Kendrick & Sons, Ltd., Birmingham	England	1800	175	Melting ferromanganese
Steel Castings, Ltd., Birmingham	England	2500	200	Steel castings
Electro-Flex Steel Ltd., Dunston	England	5000	350	Steel castings

Total, 38; operating in the steel industry, 33.

Table 7—Miscellaneous Electric Furnaces, Other than Heroult, Girod, Induction, Rennerfelt, Snyder and Wile Building or Operating in Europe and Other Countries as Shown by Literature on the Subject. Partly Estimated

Type	No.	Type	No.
Stassano	15	Stobie	4
Keller	8	Anderson	4
Chapelet	5	Soderberg	1
Grönwall	14		
Nathusius	4	Total in Europe	55

The accuracy of this table is not vouched for, being based on the best information obtainable owing to the war and other reasons. It is believed to be nearly correct.

Table 8—Types of Electric Furnaces by Countries of the World Operating or Contracted for on Jan. 1, 1916, with Totals for 1915, 1913 and 1910

Countries	Heroult	Girod	Induction	Stassano	Keller	Chapelet	Nathusius	Snyder	Wile	Rennerfelt	Grönwall	Special	Total Jan. 1, 1916	Total Jan. 1, 1915	Total July 1, 1913	Total March, 1910
Germany and Luxemburg	19	6	19	2	3	..	4	..	..	..	..	..	53	46	34	30
Austria-Hungary	10	3	3	2	..	..	..	..	..	..	..	..	18	18	10	10
Switzerland	1	2	..	..	..	..	..	..	..	1	..	..	4	3	2	2
Italy	4	1	2	5	5	5	..	..	..	..	..	..	22	22	20	12
France	11	7	2	..	..	..	..	..	..	1	..	..	21	17	13	23
England	20	1	2	4	..	..	..	3	..	4	12	..	46	16	16	7
Belgium	2	1	..	..	..	..	..	..	..	..	..	..	3	3	3	3
Russia	3	1	1	2	..	..	..	..	..	4	..	..	11	9	4	2
Sweden	2	..	1	..	..	..	..	..	..	20	..	..	23	18	6	5
Norway	..	..	2	..	..	..	..	..	1	3	..	..	6	2	3	..
Spain	..	..	1	..	..	..	..	..	..	..	1	..	2	1	1	..
Japan	..	..	1	..	..	..	..	..	..	..	..	..	1	1	1	..
Mexico	..	..	1	..	..	..	..	..	..	..	..	..	1	1	4	3
Australia	..	..	..	..	..	..	..	..	..	..	1	..	1	1	..	..
Chile	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..
Location not given	..	..	..	..	..	..	..	..	..	..	..	9	9	12	..	..
Total outside the United States and Canada	72	22	35	15	8	5	4	4	1	33	14	9=222	170	118	101	
United States	40	4	3	3	..	..	..	12	6	2	1	2= 73	41	19	10	
Canada	3	..	..	..	..	..	..	2	1	..	..	2= 8	2	3	3	
Total in the United States and Canada	43	4	3	3	..	..	..	14	7	2	1	4= 81	43	22	13	
Grand total in the world	115	26	38	18	8	5	4	18	8	35	15	13=303	213	140	114	

now there are 33 or 38, counting the brass and other furnaces. The induction type has had a net increase of 5 furnaces. The Snyder furnace has entered the European field with 3 in England and the Wile with 1 in Norway. The Grönwall has advanced from 6 to 14 in Europe, 10 of these in England alone.

PROGRESS IN THE WORLD

While the United States has displaced Germany, having 73 electric furnaces against that country's 53, Germany ranks second. A year ago Germany had 46 and the United States 41. England in the year has advanced from fourth to third position with 46 furnaces, Sweden standing next with 23 and Italy and France with 22 and 21, respectively. Italy was third a year ago. The gain in the world's total in 1915 has been 90 furnaces or 42.3 per cent, or a total of 303 to 213 a year ago.

A striking development from a world point of view has been the increase in the use of certain types of furnace. First among these is the Heroult, which has increased from a total of 75 on Jan. 1, 1915, to 115 on Jan. 1, 1916, or 40 per cent of the world's total, a remarkable growth. Induction furnaces rank second with a net gain of 2, the total being 38. The Rennerfelt is third with a net increase of 17 or from 18 to 35. The net increase of the Grönwall is 8 with a total of 15.

In one important respect the United States is behind Europe and Germany in particular in the use of the electric furnaces in melting ferromanganese. Europe has 17 furnaces engaged in this field alone, 16 of which are in Germany, while the United States has only 2, one Heroult and one Wile. The importance of this phase of the electric steel industry is more vital than is suspected by many and without doubt developments in this country in 1916 will be important in this respect.

In two and one-half years, or since this review was first published on July 1, 1913, the world's electric steel industry has more than doubled—from a total of 140 to 303. In the same period that of the United States has nearly quadrupled—from 19 to 73 furnaces.

New Iron and Steel Works Construction

Open-Hearth Steel Capacity Now Building 4,265,000 Tons a Year—That Completed Last Year Represented 1,405,000 Tons

The year 1915, as regards new work initiated or planned, representing additions to blast furnaces and steel making capacity in the United States, is far and away beyond 1914. New work of this character, much of which will probably be completed in 1916, represents a new record in the industry, especially as regards new open-hearth capacity.

Ten new blast furnaces were projected last year, on which work will be done in 1916, as compared with only three in 1914. They include one 500-ton furnace for the Midvale Steel & Ordnance Company at Coatesville, Pa., two 600-ton furnaces for Corrigan, McKinney & Co., Cleveland; one 500-ton furnace for the Youngstown Sheet & Tube Company, Youngstown, Ohio; one 550-ton furnace for the Republic Iron & Steel Company, Youngstown, Ohio; and one 400-ton furnace for the United Furnace Company, Canton, Ohio, in connection with the new steel plant of the United Steel Company, Canton, Ohio. The Steel Corporation, at its Gary plant, Gary, Ind., will build four blast furnaces. The total capacity of these ten furnaces is 1,750,000 gross tons per year. The two furnaces of the Minnesota Steel Company, Duluth, Minn., rated at 280,000 tons a year, were completed late in 1915.

As regards open-hearth steel capacity added and open-hearth furnaces planned for early construction 1915 not only exceeds the record of 1914, but also the remarkable showing made in 1913. The present summary shows 29 such furnaces completed in 1915 with an annual capacity of 1,405,000 gross tons, while in 1914 the total completed was only 17, with an annual capacity of 1,215,000 tons. In 1913 the figures were 51 furnaces with an annual capacity of 2,920,000 tons. The additions to open-hearth capacity in 1915 were the following: Seven 75-ton furnaces of the Minnesota Steel Company, Duluth, Minn.; four 75-ton stationary furnaces of the Lackawanna Steel Company, Buffalo; two 80-ton furnaces of the Republic Iron & Steel Company, Youngstown, Ohio; two 50-ton furnaces of the Andrews Steel Company, Newport, Ky.; six 60-ton furnaces of the Bethlehem Steel Company, South Bethlehem, Pa.; one 200-ton furnace of the Phoenix Iron Works, two 90-ton furnaces of the Pittsburgh Crucible Steel Company, Midland, Pa., and three 75-ton furnaces of the Youngstown Sheet & Tube Company, Youngstown, Ohio, together with two small furnaces for small steel castings and other companies. The total additions of the year are therefore summarized as follows:

New Open-Hearth Furnaces Built in 1915

	Number Furnaces	Annual Capacity, Gross Tons
Independent companies	22	1,125,000
United States Steel Corporation	7	280,000
Total	29	1,405,000

Furnaces under construction, many of which will be completed in 1916, number 91, an amazing total, which compares with only 46 two years ago, with a capacity of 2,530,000 gross tons, regarded at the time as a remarkable showing. The Steel Corporation is represented on the list of projects by three furnaces at the plant of the Minnesota Steel Company, three at the Ohio works of the Carnegie Steel Company at Youngstown, Ohio, three 60-ton furnaces at the Donora, Pa., works, and one additional at the Newburg, Ohio, plant of the American Steel & Wire Company, four furnaces at the Lorain, Ohio, works of the National Tube Company, two 100-ton tilting furnaces with two 25-ton Bessemer converters at the South works of the Illinois Steel Company and two 100-ton furnaces with two 25-ton converters at the Gary Works of the Indiana Steel Company, making a total of 18 furnaces. Work which the independent steel companies now have under way or planned includes eight 75-ton furnaces of the Inland Steel Company, Indiana Harbor, Ind.; two 75-ton furnaces of the Lackawanna Steel Company, Buffalo; four 75-ton furnaces of the Lukens Iron & Steel Company, Coatesville, Pa.; one 75-ton furnace of the Central Iron & Steel Company, Harrisburg, Pa., which company will also enlarge its present four 60-ton furnaces 25 per cent; six 80-ton furnaces of the United Steel Company, Canton, Ohio; one 85-ton furnace of the Brier Hill Steel Company, Youngstown, Ohio; two 75-ton

furnaces of the Standard Steel Works Company, Burnham, Pa.; eight 75-ton furnaces of the Bethlehem Steel Company, South Bethlehem, Pa.; three 80-ton furnaces of the Pittsburgh Steel Company, Monessen, Pa.; three 75-ton furnaces of the Standard Steel Car Company, Butler, Pa.; three 100-ton furnaces of the Youngstown Sheet & Tube Company, Youngstown, Ohio; one 200-ton furnace of the Phoenix Iron Works, Phoenixville, Pa.; four 50-ton furnaces of the Central Steel Company, Massillon, Ohio; six 50-ton furnaces of the Midvale Steel & Ordnance Company, Coatesville, Pa.; eight 75-ton furnaces of Corrigan, McKinney & Co., Cleveland, Ohio; one 40-ton furnace of the Atlantic Steel Company, Atlanta, Ga., besides a new plant of several furnaces of the Wickwire Steel Company, Buffalo. The prospective increased capacity thus stand as follows:

New Open-Hearth Furnaces Under Construction

	Number Furnaces	Annual Capacity, Gross Tons
Independent companies	73	2,715,000
United States Steel Corporation	18	1,550,000
Total	91	4,265,000

A year ago new furnaces under construction showed a total of only 42, with an annual capacity of 1,750,000 gross tons.

Lehigh Plant

Blast Furnace B has been dismantled, and will be rebuilt during the coming year as a modern 500-ton furnace, with five 22 x 100-ft. stoves, making it exactly similar to the other five large furnaces. This rebuilt blast furnace B will be blown by two single-tandem gas-driven blowing engines, Bethlehem design and manufacture.

Blast Furnace C, which was rebuilt along modern lines and equipped with electric skip hoist in 1914, was held in reserve until Aug. 29, 1915, when it was blown in.

A new Uhling type of pig casting machine is being installed, and will be put in operation in the next sixty days.

NEW MILLS

All the mills in the new mill No. 2, except the 18-in. continuous mill, were put in service during the last six months, including the 35-in. reversing motor-driven blooming mill, the 22-in. 4-stand merchant mill, the 10 and 12-in. mill, 12 and 8-in. mill, and 10-in. mill. All these mills are motor driven and the electrical installation has been very satisfactory. The bar mills are all producing special steel, including various alloy steels.

The reconstruction of the building over the puddle mill furnaces and rolling mill is well under way and will be completed in the next three or four months.

The two new mills for the crucible department, namely, 16 and 12-in., and 12 and 8-in., have been received and will also be installed during the coming spring. These mills are also motor driven.

OPEN-HEARTH FURNACES

Of the six open-hearth furnaces being installed for additional steel-making capacity for the Lehigh Plant in open-hearth No. 3, four are completed and two were lit in December, 1915, and are now making steel. The other four will be put in service in January, 1916.

A new 100-ton ladle crane has been purchased and installed in open-hearth department No. 1.

The 10-ton Girod electric furnace has been entirely completed, but has not yet been put into service, because the electric power generating capacity, which was installed for this furnace, has been temporarily used for other purposes.

ELECTRIC POWER HOUSE AND OTHER BUILDINGS

The extension for three additional 3,000-kw. AC Bethlehem gas engine driven generators was completed and put into service the middle of the year, and a further extension is now partially constructed for four more of the same size gas-driven generators. All of the gas engines are twin tandem compound, and are Bethlehem design and manufacture.

A large and efficient water-cooling pond, to filter and cool the water used by all the gas engines, will be installed in 1916.

A new safety and welfare building is now under way, and will be completed early in the spring. It will be thoroughly equipped for the various phases of first-aid work.

A new scrap-breaking plant, located on the cinder dump, is just about completed and this central plant will entirely replace the three isolated crane runways now in service at various parts of the company's property.

Two additional 30-ton locomotive cranes were purchased and put in service last fall, as well as two broad-gage locomotives and two narrow-gage locomotives.

A new car dumper complete, with bins and railroad tracks, has been authorized. It is to be of the "single" type, and will be installed as a spare unit in addition to the two-car dumper now in service.

A new general office building, being an addition to the present building and of about the same general dimensions and outside appearance, will be erected west of the present location. Plans are completed, but construction has been temporarily held up.

In 1915 the company built and fully equipped a one-story building, 150 by 210 ft., for the use of Battery A, field artillery, Pennsylvania militia, which is largely made up of men employed in various departments of the steel company. The battery building, which is of brick and steel construction, consists of drill hall, gun shed, stable, quartermaster's storage, harness rooms, locker rooms and shower bath. The field equipment of the battery is of the latest United States Government standard, and the guns, gun carriages, limbers, and caissons are of Bethlehem manufacture.

NEW PRESSES

A 2000-ton forging press has been authorized, with its full equipment of heating furnaces, cranes, etc. It will be installed, in the coming spring, contiguous to our present forging press equipment.

A new hammer shop, with full equipment, is being provided for housing the present hammer forge equipment, which is being moved to provide room for the new 2000-ton press above.

For the treatment department a 1500-ton straightening press is being constructed and a large additional building 62 x 238 ft., is now being built for increasing the capacity for heat treating medium size forgings.

ORDNANCE SHOPS AND ORE-UNLOADING PLANT

Extensive additions have been made during the past year to all machine and forge shops in which finished ordnance and its materials are manufactured. Some of these extensions are still in course of construction and equipment, including the rebuilding of that portion of No. 4 machine shop and its equipment that were destroyed by fire on Nov. 10, 1915. It is believed that these extensions will be largely completed during the early part of 1916.

The Lehigh Valley Railroad is building a new pier, 1160 ft. long and 84 ft. wide, at Constable Hook, N. J., and the steel company has made arrangements for the erection of unloading machinery on this new pier for the unloading of its foreign ores. A channel has been provided, giving a depth of water to the dock of 35 ft. at mean low tide, so that large sea-going vessels can be docked at this pier. The pier will be ready for operation in the early part of the year 1916. The steel company will erect on the pier two unloading machines, one

large Hulett walking-beam type furnished by the Wellman-Seaver-Morgan Company, Cleveland, Ohio (the capacity of the bucket on this machine being 17 tons), and one lighter crane type machine for the smaller seagoing vessels (the capacity of the bucket being 5 tons), being built by the Mead Morrison Manufacturing Company, of Boston, the combined capacity of these two machines is 1000 to 1400 tons per hour, depending upon the construction of the boats being unloaded.

Saucon Plant

A new general office building and first-aid station, with new entrance gates, etc., have been completed and put into service during 1915.

Waste heat boilers were installed at all sixteen open-hearth furnaces, as well as over the two continuous heating furnaces for the 28-in. structural mill.

Excavations are well under way for eight more 125-ton open-hearth furnaces and work will be pushed to completion in 1916.

A new repair machine shop, roll shop and electrical repair shop, thoroughly equipped in every respect, were completed and put into operation in 1915. The original shops were removed to make room for a new beam mill.

An extension to the bridge shop was completed in the past year, 90 x 400 ft., fully equipped with punches, shears, and other tools necessary for the fabrication of medium and light-weight structures.

A 3-high 18-in. mill and a 2-high 12-in. modified continuous mill, with 10 stands of rolls, both mills being electric driven, intended for rolling beams, channels and angles, all with full equipment of heating furnaces, shears, cooling beds, and transfer tables, have been under construction during the latter part of 1915, and will be completed in 1916.

Youngstown Sheet & Tube Company

The extension program adopted by the Youngstown Sheet & Tube Company, Youngstown, Ohio, early in 1915, called for an appropriation of $5,000,000. As the year progressed, however, this program was materially extended.

BLAST FURNACES

On Dec. 14, 1915, the construction of a fifth blast furnace was authorized. The four blast furnaces already in operation, although rated at 500 tons, have averaged 602 tons daily for months. The new stack is designed on similar lines and will probably even exceed this average. The additional blast furnace will be begun soon.

NEW BAR MILLS

Other extensions are in various stages. Notable among those under way is a train of bar mills. Among those approaching completion are two Morgan continuous merchant bar mills, one a 9-in. and the other a 12-in. mill. The 9-in. mill has a continuous roughing mill of six stands, a continuous finishing mill of six stands and one Edwards sizing mill. The capacity of this mill, under normal conditions, will be 6000 tons of average sections per month. The roughing mill will be driven by a 37 x 48-in. Nordberg Uniflow engine. Two stands of finishing rolls will be driven by a 700-hp. direct-current Crocker-Wheeler motor. Four stands of finishing rolls will be driven by two 600-hp. direct-current Crocker-Wheeler motors. The sizing mill will be driven by a 100hp. direct-current Crocker-Wheeler motor. The 12-in. mill has a continuous roughing mill of five trains and a finishing mill of two trains, each of two stands of staggered duo type. The capacity of this mill under normal conditions should be 10,000 tons of average sections per month. This mill will be driven by a 44 x 50-in. Nordberg Uniflow engine.

The 9-in. mill building is 90 x 1150 ft. The 12-in. mill building is 100 x 401 ft. These buildings contain 3000 tons of steel and have roofs of the Pond type, and are among the largest mill buildings in America. The 9-in. and 12-in. mills are each served by two 15-ton Cleveland cranes and the billet yard and warehouse by one 15-ton Cleveland crane for each. These mills contain 15 alternating-current motors and 50 direct-current motors for crane and general mill service.

OPEN-HEARTH DEPARTMENT

Work is well under way on the construction of three 100-ton furnaces at the eastern end of the present open-hearth plant. In connection with these furnaces will be installed six Morgan mechanical gas producers, one 165-ton Morgan ladle crane, one Morgan low-type charging machine, and three 616-hp. Babcock & Wilcox waste-heat boilers. The completion of these furnaces will make a battery of nine. Those now in operation are averaging 125 tons per heat.

A new mixer plant is being built for the open-hearth department, which will contain a 1300-ton hot metal mixer, built by the Pennsylvania Engineering Works.

THE COKE PLANT

The coke plant will contain 104 Koppers' cross regenerative coke ovens, 12¼ tons each, designed for 15-hr. coking time, arranged in batteries of 51 ovens each, with a by-product plant for the recovery of tar, and the Koppers' direct process for the manufacture of ammonium sulphate. A Semet-Solvay benzol plant is in course of construction. The coal will be handled by a Wellman-Seaver-Morgan car dumper, which will deliver at either an 8-ft. or 62-ft. lift. The coke handling and screening station is being built by the Robins Conveying Belt Company.

The boiler house will contain four 768-hp. Babcock & Wilcox boilers, fitted with Parsons distributors and fired with coke breeze and carrying 175-lb. working steam pressure and 100 degrees of superheat.

The electrical sub-station will contain three Crocker-Wheeler 1200 kva. synchronated motor-generators for transforming the 6600-volt alternating current to 240-volt direct-current, and a bank of three 500-kva., 6600-volt to 240-volt alternating-current transformers. The plant will be in operation in the spring.

SPECIAL FINISHING MILLS

An 18-in. finishing mill has been installed expressly for the purpose of rolling iron and will be used extensively in making socket iron from which couplings for Youngstown pipe are made. This mill is completely equipped and is driven by a Tod 24 and 44 x 48-tandem compound engine.

Blooming mill No. 1 has been equipped with two 54-in. hot saws with accessory tables, conveyors, etc., for handling square end forging stock.

Skelp mill No. 2 has been equipped with tables, conveyors, cooling beds, hot saws, etc., for the handling of large rounds.

A General Electric Company 5000-kw., alternating-current, 6600-volt high-pressure turbo generator is being added to power house No. 2, to provide increased power for the coke plant and additions at the main plant.

A new power house is being built at the rod and wire department. This will contain three General Electric 1500-kw., direct-current, 240-volt high-pressure turbo generators to provide power for the new merchant mills.

BOILER AND PUMP HOUSES

A new boiler house, No. 6, at the rod and wire department, will contain six 764-hp. Babcock & Wilcox boilers, fitted with Sanford-Riley 10-retort underfeed stokers. Eleven boilers in boiler house No. 3 have been

equipped with Sanford-Riley 6-retort underfeed stokers, supplanting stokers of an old type. This boiler house has also been provided with an additional ash hoist.

A new pump house, No. 14, at the merchant mills, will contain four DeLaval turbine driven pumps each with a capacity of 15,000,000 gal. per 24 hr., two against a head of 135 ft. and two against a head of 85 ft.

A new pickling building has been added to the rigid conduit department. This is a building of brick and steel construction, 60 x 260 ft., and contains a vertical pickling unit of 10 vats.

Thirty barbed wire fence machines have been added to the fence department.

GENERAL OFFICE

The company is building a new general works office, located at the main plant, to contain the offices of the vice-president, general superintendent, order department, purchasing department, time office, safety department and engineering department, and will be equipped with a modern restaurant. The building is a 4-story fireproof structure of brick and steel, 158 ft. front, 141 ft. on one wing, and 90 ft. on another, and has a total floor space of 57,800 sq. ft.

GENERAL LABORATORY AND HOSPITAL

The general laboratory is located across the street from the new general office, and is a fireproof structure of brick and steel. It has two stories and basement, with a frontage of 115 ft. and two wings 88 ft. The two stories will have a total floor space of 7140 sq. ft.

The emergency hospital is being built near the East Youngstown entrance to the main plant and is a fireproof structure of brick and steel. It has two stories and basement, with 85 ft. frontage and 49 ft. depth. It will contain offices for the accident clerk and assistants, two examination rooms, two emergency wards, dispensary, operating room, instrument and supply room, two large waiting rooms, a kitchenette, two doctor's bedrooms, one nurse's bedroom, one doctor's living room and one nurse's living room.

The total cost of these improvements and extensions will be approximately $7,000,000.

Crucible Steel Company of America

Additions made by this company to its various plants in the Pittsburgh and Eastern districts in 1915 were much smaller than in any previous year for a long time. This was largely because conditions in the steel trade were very much depressed in the first half of 1915, while in the second half conditions were very active, and the company gave practically all its attention to taking care of its rapidly expanding business.

Crescent Works: A new machine shop building was erected of brick and steel construction, and equipped with modern iron-working tools. Some smaller shops are contained in the new building.

Park Works: Some minor additions to equipment were made, including the equipment of the heating furnaces in the blooming mill with furnace stokers to increase the efficiency and to eliminate smoke.

LaBelle Works: The heat-treating department in this plant was enlarged and some new equipment added.

Singer-Nimick Works: It was contemplated to install stokers and make other improvements to boilers, but owing to the depression in the steel trade this work was not carried out. It will probably be undertaken and completed during 1916.

Spring Works, McKee's Rocks: The water supply at this plant at McKee's Rocks, and some additions and improvements to the heating furnaces were installed during the year.

Atha Works: At this plant, in Harrington, N. J., a new 20-in. motor-driven cogging mill to break down 4 x 4-in. billets was completed and put in operation.

Syracuse Crucible Steel Company: It was expected to complete this plant during 1915 for the manufacture of high-grade tool steels, but owing to the depression this was not carried out. The company has the buildings completed and ready for the furnaces and other equipment, which will likely be installed during 1916.

PITTSBURGH CRUCIBLE STEEL COMPANY

At this company's plant, at Midland, Pa., two more 90-ton acid open-hearth furnaces were added last year, the plant now containing six basic and four acid open-hearth furnaces, all 90 tons capacity per heat. There was also completed at this plant early in 1915 a reversing bar mill, a plow mill and coulter and disc shops. The requirements of the finishing mills at Midland being largely for 4 x 4-in. billets, it was found necessary to add an auxiliary 28-in. billet mill to take care of the increased output of open-hearth steel by reason of the building of the two new furnaces, and this relieves the pressure on the 40-in. blooming mill, which is used more largely now to roll heavier sections. It is expected to have this new mill completed early in 1916, and the maximum tonnage of the open-hearth steel plant will be taken care of, and a more adequate supply of billets will be furnished to the finishing mills.

There is also being built at Midland a Carnegie free library and it will be completed early this year, for the use of the employees. During the year this company also built a large number of houses for the use of superintendents and other employees. The Midland Savings & Trust Company was also organized at Midland during the year, with a capital and surplus of $175,000, and built a very fine banking house. Most of the employees of the company deposit their savings in this institution, and above the banking rooms sleeping rooms have been arranged for unmarried office employees, and a large library and club rooms have been added.

CRUCIBLE FUEL COMPANY

This is the coal department of the Crucible Steel Company of America which has been greatly increasing its output, supplying at the present time nearly 1500 tons of coal per day to its various mills. Owing to the increased consumption of coal and to secure additional facilities and equipment, also prompt deliveries, the company built a number of steel barges during 1915 to transport coal from its mines to its mills, each barge having a carrying capacity of about 1000 tons of coal.

Wheeling Steel & Iron Company

The Wheeling Steel & Iron Company is making large additions to its plants in Benwood and Wheeling, W. Va., and also to its tin-plate works at Yorkville, Ohio. This latter plant now contains twelve hot tin mills and twelve more 28-in. mills will be added, work now going ahead on six mills, which will be finished about April 15 or May 1, and the other six mills about Oct. 1 this year. Additions are being made to the various buildings to accommodate the new mills, and other equipment that will be added, as follows: The hot mill building is being increased 60 x 450 ft., the bar house, 72 x 450 ft., the opening and sorting room, 45 x 450 ft., the annealing department, 72 x 450 ft., and the tin house and warehouse, 150 x 500 ft. The twelve new mills are being built by the Wheeling Mold & Foundry Company, Wheeling, W. Va.; the new tinning pots will be built by the company itself, while the additions to the buildings will take 1500 tons of steel, which will be fabricated and erected by the Fort Pitt Bridge Works of Pittsburgh, with works at Canonsburg, Pa. Contracts for two new engines for driving the twelve new hot mills have been placed with the Bass Foundry & Machine Company, Fort Wayne, Ind., the engines each to be 32 x 60 in., and to be equipped

for rope drive. Contracts for twelve heating furnaces and five annealing furnaces have been placed with the George J. Hagan Company, Pittsburgh. Some entirely new ideas in construction and design will be involved in the building of these heating and annealing furnaces. Contracts for the other equipment, including cranes, will be placed in a short time. When the twelve new mills are completed and in operation, the Yorkville plant will have a capacity for turning out 2,000,000 boxes of tin plate per year.

In the Wheeling district, the Wheeling Sheet & Tin Plate Company is building a new combination mill to roll skelp or tin bars. It will have a capacity of about 800 tons of skelp per day in sizes wide enough to make 8-in. pipe, and probably up to 16 in. It will also roll about 800 tons of tin bars per day to be used in the tin-plate plant at Yorkville. This mill is of entirely new design of the Fawell type and is being built by Mackintosh, Hemphill & Co., Pittsburgh. The company will also revamp its Bessemer steel plant in Wheeling and its tube works at Benwood, and both will be made thoroughly modern. Probably a new warehouse will be built, the galvanizing department enlarged and the present crane service in Benwood and Wheeling will be greatly extended. The company expects to have these additions completed by Oct. 1.

Pennsylvania Steel Company

This company at its Steelton works, Steelton, Pa., completed in 1915 a 44-in. blooming mill, a 35-in. roughing mill and a 28-in. rail and structural and finishing mill, besides an iron-ore yard and bridge for stocking and handling iron ore. A blast furnace of 450 tons daily capacity was also built. An eye-bar plant was constructed and one large heating furnace and forge plant, together with a second forging unit consisting of four light presses with the necessary furnaces, etc. In 1916 at its Steelton works this company will construct 14-in. and 16-in. merchant mills, a new plant for sintering flue dust from blast furnaces and fine ores and an extension to the machine shop with additional machine tool equipment. No. 3 blast furnace will be remodeled and reconstructed, and extensions will be made to the blast-furnace power plant consisting of one gas-driven blowing engine and one 3000-kw. gas-driven electric generator. A 2400-hp. boiler plant will also be built.

At its Lebanon works, Lebanon, Pa., the company will add to its ore concentrating and sintering plant.

Maryland Steel Company

At this company's plant at Sparrows Point, Md., a continuous reheating furnace to be used in connection with rail mills was completed in 1915, as well as three reciprocating gas compressors, the remodeling and reconstruction of No. 4 blast furnace and the enlarging and rebuilding of two shipbuilding berths with traveling crane equipment. In 1916 the company plans to build a new machine shop building with additional machine tool equipment in the marine department, an extension to the boiler shop, a new fabricating and mold loft, four new cranes and runways for the storage yard and one new shipbuilding berth with traveling crane equipment.

Midvale Steel & Ordnance Company

This company, the new owner of the Worth Brothers Company, Coatesville, Pa., late in 1915 broke ground for the erection of six new 50-ton open-hearth furnaces adjoining the present plant. It is expected that these will be in operation early in 1916. A new blooming mill is to be built located between the steel plant and the plate mills, considerably increasing the output of the plate mills. Two 750-kw. turbo generators will also be installed. The company recently purchased 205 acres from the Craig Ridgway & Sons Company, making the total holdings about 905 acres.

A new 500-ton blast furnace is also to be built at Coatesville, having a capacity of 175,000 tons per year. Ore yard and gas engine equipment sufficient for a fourth blast furnace are to be authorized early in 1916.

New 8-in., 12-in. and 15-in. bar mills have been authorized for 1916, as well as a steel tire and a rolled steel wheel department and a forging department in which will be one 2500-ton hydraulic press, one 1500-ton hydraulic press and two draw benches.

New equipment, chiefly hydraulic and electrical machinery, is being purchased for the company's Midvale plant at Nicetown, Pa.

Corrigan, McKinney & Co.

The new plant of Corrigan, McKinney & Co., Cleveland, Ohio, was practically completed last year, and it is planned to start it up early in January. With the finishing work on its steel plant this firm has gone ahead with the construction of its two additional 22 x 90-ft. blast furnaces each with a daily capacity of about 600 tons. One of these furnaces will be completed some time in January, and the second during the spring or early summer. The steel plant comprises eight 75-ton open-hearth furnaces, a 40-in. blooming mill, a 21-in. and an 18-in. continuous sheet bar and billet mill, and a 1000-ton hot metal mixer. The only new work planned or started during the past year was the building of 204 12¼-ton Koppers by-product coke ovens which will probably be completed late in the summer. Although this firm included a finishing department in its original steel plant plans it has no further extension work under contemplation for the present year.

The Wickwire Steel Company

The Wickwire Steel Company, Buffalo, N. Y., will build in 1916 steel and wire mills of about 400 tons daily capacity adjoining the blast furnace plant on the Niagara River. The new plant will consist of open-hearth furnaces, a metal mixer, a blooming mill, a continuous billet mill, a rod mill and wire mills for making market wire and heavy sizes of finished wire, etc.

A by-product coking plant is to be erected in connection with the steel mill additions by the Semet-Solvay Company, Syracuse, in accordance with an agreement with the Wickwire Company. It will consist of a battery of sixty ovens and the Wickwire Company will use part of its coke in its blast furnaces; the coke oven gas will be used in the new steel and wire mills.

Inland Steel Company

The Inland Steel Company, Chicago, erected in 1915 at Indiana Harbor, Ind., a benzol recovery plant, a sintering plant and a Hoover & Mason ore unloading bridge. The benzol plant was in operation early in June and the sintering plant early in October. During 1916 the company will build eight open-hearth furnaces of 75 to 80-ton capacity, a 40-in. motor-driven blooming mill, a 28-in. motor-driven structural mill with all the necessary equipment, including gas producers, strippers, crane runways, soaking pits and trestle work. Other finishing mills are contemplated but not decided upon.

Lackawanna Steel Company

The Lackawanna Steel Company, Buffalo, added four open-hearth furnaces to its No. 2 plant and placed them in operation during 1915. Two additional furnaces, Nos. 21 and 22, are now under construction to be operated early in 1916. To take care of these extensions the gas producer plant has been expanded by the addition of six mechanically operated producers, including coal handling facilities. An additional 165-ton ladle

crane and a 5-ton charging machine, together with the necessary ladles, ingot cars, etc., are being installed for these furnaces.

An additional bar mill, to be known as No. 10 mill, is under construction and will be completed in 1916. It will produce ⅜-in. rounds and under, also small tees, angles and flats.

A 20-ton gantry crane was built in the company's shops in the past year and placed in operation at the billet storage yard. A second gantry crane of the same size and capacity is being constructed at the billet yard and will be completed early in 1916. Three additional 15-ton locomotive cranes equipped with turbo-generator sets for supplying current for lifting magnets have been installed for general plant use.

A benzol plant has been added to the company's by-product coke ovens. The power plant is being enlarged by extending feeder station No. 2 by installing 1000-kw. motor generator set, together with transformer, switchboard, etc.

LaBelle Iron Works

Improvements and additions made by this company to its plants at Steubenville, Ohio, and Wheeling, W. Va., during 1915, were less than usual. Minor additions were made to equipment during the year representing about $200,000. In September the company placed a contract with the H. Koppers Company, Pittsburgh, for the building of 94 by-product coke ovens, which are now being constructed on a plot of ground across the Ohio river from its plant. There will also be a benzol plant to take care of the by-products, and the new ovens are expected to be finished about July 1. They will make about 1000 tons of coke per day, enough to supply the two blast furnaces of the company at Steubenville. The company will also likely start erection this year of a single track steel bridge across the Ohio river to take coke from the new by-product ovens to the blast furnaces. This bridge will require 5000 to 6000 tons of steel.

Youngstown Iron & Steel Company

This concern completed in the latter part of 1915 a new open-hearth steel plant, located adjacent to Mary furnace of the Ohio Iron & Steel Company at Lowellville, Ohio. The steel plant contains three 75-ton open-hearth furnaces and a blooming mill, and the company will use the direct-metal process, securing its material over its own tracks from the Mary blast furnace. The company will also install a sheet bar mill, which has been built by the William Tod Company at Youngstown, but which has not been erected. The company will make its own sheet bars for its eight sheet mills at Youngstown and will also likely be a seller in the open market. The new open-hearth plant is very modern in construction throughout, having electric drive entirely, and has already made some remarkable records in output. The sheet-bar mill will be installed early this year. The plant has been designed to add three more open-hearth furnaces, which will be built when the additional output is needed.

Central Steel Company

This company completed early in 1915 a new open-hearth steel plant at Massillon, Ohio, which was fully described in THE IRON AGE of Jan. 7, 1915. A short time after the plant was started a revival in the steel business took place, and the company found its supply of steel inadequate to meet its demands, and on Aug. 10, 1915, it placed a contract with the S. R. Smythe Company of Pittsburgh for four 50-ton open-hearth furnaces, three basic and one acid, which are now being built, the Smythe Company having erected the original steel plant of three 50-ton furnaces. The Smythe Company will also build the gangways and tapping plant, and it is probable that this year the company may install some additional finishing mills. It rolled its first heat on Monday, June 7, 1915, amounting to about 60 tons, and heats were taken off continuously after that. On Thursday, June 10, the blooming mill was put in operation, and the first ingot cast, from which was rolled a 4 x 4-in. billet. In this plant the blooming mill and all other equipment are electrically driven and controlled without a steam line, or any line shafting or belting in the operation. The company buys its electric energy from a lighting plant in Massillon. It is considering the addition of a bar mill but plans have not been decided.

Jones & Laughlin Steel Company

No additions of note were made by the Jones & Laughlin Steel Company at its South Side or Aliquippa, Pa., works during 1915. The company brought all its equipment up to the very highest state of efficiency possible, in order to meet as well as it could the heavy demands on it in the last half of last year.

The only new work started during the year was the building of two lap weld and two butt weld pipe furnaces and a skelp mill at its Aliquippa works. Excavation work for these new mills was started early in September last year, but owing to the very active conditions in the steel trade the work of building them has not been pushed very extensively. The company will not be a producer of pipe until late this year and expects, when the furnaces are finished, to turn out all sizes of lap and butt weld steel pipe running from ½ in. to 16 in. in diameter.

Pittsburgh Steel Company

In October last year the Pittsburgh Steel Company started the erection of three 80-ton open-hearth furnaces in its plant at Monessen, Pa., which are not yet completed and is also making some minor additions to its wire drawing capacity. It also added additional ore bins to increase its facilities for ore storage and also enlarged its coal handling equipment.

Standard Steel Car Company

This concern, whose large works are at Butler, Pa., embracing open-hearth steel plant, foundries and steel car works, is building three more 75-ton open-hearth furnaces and has also made some minor additions to its finishing departments. It increased its capacity in the manufacture of forged steel wheels and, it is reported, will go into the manufacture of motor trucks on an extensive scale during this year. The company now has a capacity for turning out close to 75 finished steel cars per day.

Phillips Sheet & Tin Plate Company

The Phillips Sheet & Tin Plate Company, operating tin-plate plants at Weirton and Clarksburg, W. Va., and Steubenville, Ohio, and also a cold-rolled strip steel mill at Weirton, will engage in the manufacture of hoops and bands. It has placed a contract with the William Tod Company of Youngstown, Ohio, for a 16-in. continuous mill for rolling hoops and bands. It will also erect four new buildings taking about 900 tons of steel, contract for which has been placed with the Penn Bridge Company of Beaver Falls, Pa. The new mills will be motor driven, current being secured from the present central power plant of the company. It has placed a contract for all the new electrical equipment with the Westinghouse Electric & Mfg. Company, and will also install two 3000-kw. Westinghouse turbines. The company has just completed and will start on Monday, Jan. 10, four new hot tin mills, giving it a total of twenty-four hot tin mills at Weirton, twelve at

Clarksburg and twelve at Steubenville, or forty-eight in all. These forty-eight hot mills are expected to turn out in 1916 from 4,300,000 to 4,500,000 boxes of bright and terne plate, black plate for tinning, special enameling stock and other similar products. A new two-story office building is expected to be ready about April 1. It will spend altogether $1,000,000 in new additions, all of which will probably be completed about July 1 next, consisting of two continuous 2-stand rolling mills at its plant in Weirton, W. Va., at a cost of $1,000,000.

Republic Iron & Steel Company

The Republic Iron & Steel Company, Youngstown, Ohio, completed in 1915 two 80-ton open-hearth furnaces which are duplicates of the present ones. These additions will make twelve furnaces in all. A by-product coke plant of 75 ovens was also a new installation. A complete benzol plant to take care of the gas produced by the 68 existing ovens and 75 new ovens was erected. Work which is now under way and which will probably be completed in 1916 consists of one blast furnace of 550 to 600 tons daily capacity, one butt weld pipe mill and one lap weld pipe mill for making pipe from 8 to 16 in. in diameter. Electric generating capacity sufficient to take care of the above improvements is also being added.

Lukens Iron & Steel Company

At Coatesville, Pa., this company is building four 75-ton basic open-hearth furnaces so constructed as to admit of operating them as 90 or 100-ton furnaces later if desired. The Morgan Engineering Company, Alliance, Ohio, will furnish the necessary cranes, etc. The building contracted for to house these furnaces is large enough to contain six furnaces. Contracts are being made for the various parts needed for a new 208-in. 4-high plate mill, which will be driven by double reversing engines of large size and probably compound condenser. The mill will be equipped with pit furnaces, cooling beds, shears, etc. The company is getting its big slabbing mill in condition to operate again after a long idleness, making at the same time improvements in the machinery, as well as putting up new gas producers.

A considerable enlargement of the flanging department and also of the Jacobs-Shupert locomotive fire box department have been contracted for. Arrangements are also being made to install a large turbo-generator to use exhaust steam, supplementing the one now in use.

An enlargement of the office building this coming spring, practically doubling the size, is contemplated, and it is probable that the machine shop will also be made twice its present size.

United Steel Company

The United Steel Company, Canton, Ohio, has under construction a new open-hearth steel plant to be known as its plant B, which will include six 80-ton open-hearth furnaces, a 40-in. Mackintosh, Hemphill & Co. blooming mill with a capacity of 40,000 tons per month, an 18-in. Morgan continuous sheet bar and billet mill for rolling sheet bars and small billets down to 1½ in. It plans to have three of the open-hearth furnaces in operation April 1 and the remainder July 1, this year. It is intended to have eventually 15 open-hearth furnaces in this plant. A 350-ton mixer is being installed. Electric drive will be provided for the mills. The blooming mill will be driven by a Westinghouse 12,000-hp. reversing motor and the billet mill by a 4200-hp. motor. The mill building is being erected by the Ft. Pitt Bridge Company and the crane equipment will be furnished by the Alliance Machine Company and the Morgan Engineering Company. The United Steel Company is also making an extension to its present plant, including an 8-in. bar mill which will be ready for operation about March 1, and a Lamberton jobbing, billet and bar mill to be ready to start up about February. Both mills will be electrically driven. A 15-ton Heroult electric furnace is also being installed additional to the 6-ton Heroult furnaces now in operation.

The United Furnace Company, Canton, Ohio, organized during the year by Pickands, Mather & Co., Cleveland, and United Steel Company, Canton, interests, has under construction a blast furnace with a daily capacity of 400 tons and 47 Koppers by-product coke ovens with a daily capacity of 500 tons. The furnace and ovens will be ready for operation about July 1.

The Central Iron & Steel Company

The receivers of this company plan to enlarge the four 60-ton open-hearth furnaces in 1916 so that each will be 41 ft. 6 in. x 15 ft. and 5 ft. 6 in. from the sill line to the plates of the pan, permitting a normal depth of both of 2 ft. 9 in. at the center. A 150-ton ladle crane has been received to handle the metal from these furnaces. An additional furnace as large as the reconstructed ones will be built soon. Other contemplated improvements embrace a change of grates in a battery of boilers for burning low-grade fuel, a condenser for a big Corliss engine, the extension of the shipping house and a new engine for the 89-in. plate mill.

In 1915 two Babcock & Wilcox waste-heat boilers were installed in connection with the ingot heating furnaces and several small engines have been replaced with motors. An extra heating furnace in the flanging department and one in the forge shop have added greatly to the output.

Andrews Steel Company

The Andrews Steel Company, Newport, Ky., in 1915 placed in operation the two 50-ton basic open-hearth furnaces which were completed in 1914, making a total of six furnaces all equipped for the use of natural gas, in addition to producer gas. The machine shop was made larger and several additional machines installed.

A large special research laboratory, separate from the regular laboratory, has been built to be used to carry on experiments for the improvement of the company's special products. It is claimed to be equipped with the latest and most modern equipment of any research laboratory in this country or Europe. Plans for new construction in 1916 have been abandoned because of the sold up condition of the plant.

Gulf States Steel Company

The Gulf States Steel Company, Birmingham, Ala., in 1915 practically completed the installation of a new heating furnace for billets in its rod mill department, together with appropriate producers and chimney stack, and a new and heavier billet carrier for making deliveries from the heating furnace to the continuous train in the rod mill. It has also extended the building containing the galvanizing department, installing a third galvanizing frame with spelter and lead pans. The barb wire department has also been extended for the installation of 16 new barbing machines. The blooming mill department has also been made larger by the installation of one 4-hole soaking pit fired by two gas producers, a new stack for this and a new overhead soaking pit crane. A runway through the soaking pits has been added with automatic tripping, ingot buggy for delivery to the blooming mill train. The 22-in. steam main and the hydraulic mains have been unified, uniting the steam and rod mill departments. A brick and magnesite storehouse has been added to the open-hearth department.

Other Steel Works Additions

The Upson Nut Company, Cleveland, Ohio, has completed the installation of its hot forge shop equipment, described in THE IRON AGE June 17, 1915.

The Atlantic Steel Company, Atlanta, Ga., formerly the Atlanta Steel Company, has added one 40-ton open-hearth furnace.

The Firth-Sterling Steel Company, McKeesport, Pa., purchased during 1915 additional machinery and built several new crucible furnaces.

The National Malleable Castings Company, Sharon, Pa., states that it expects to add another electric steel furnace to its equipment in 1916.

John A. Roebling's Sons Company, Trenton, N. J., in 1915 replaced the buildings destroyed by fire in January, 1915, and began the construction of an additional rope shop at its Buckthorn (Trenton) plant. Additional power has been provided at the Roebling (N. J.) plant and considerable new machinery installed both at Roebling and Trenton. New construction is planned for 1916 but no plans decided on.

The Penn Steel Castings & Machine Company, Chester, Pa., added one 8-ton acid open-hearth furnace in 1915.

The Southern California Iron & Steel Company, Los Angeles, Cal., formerly the California Industrial Company, built a 15-ton open-hearth furnace in 1915 which has been operating since April. The new plant was described in THE IRON AGE May 20, 1915.

The Eagan-Rogers Steel & Iron Company, Crum Lynne, Pa., installed in 1915 a new pattern shop, a new pattern storage building, a men's locker and wash room with shower baths, dust arresters for the sand blasts, an additional traveling crane and mold machines. The cupola has been converted into an oil-burning one, the first of the kind, and new oil-burning equipment has been installed, including a low-pressure blower for this. In 1916 the company intends to enlarge the foundry building so as to increase the capacity 50 per cent. Additional converters and molding-machine equipment is contemplated.

The Brier Hill Steel Company, Youngstown, Ohio, is building an extra 85-ton open-hearth furnace, giving it a total of eight. The company will then have a daily capacity of 1200 to 1300 tons of open-hearth steel. The company will also erect in 1916 a by-product coke plant to cost about $2,500,000, consisting of 84 ovens.

The Standard Steel Works Company, Burnham, Pa., is adding two 75-ton open-hearth furnaces, at the same time extending the building containing the open-hearth plant.

The Atlantic Steel Casting Company, Chester, Pa., which recently purchased the plant of the Keystone Steel Casting Company, built and put in operation late in 1915 a 4-ton oil-burning open-hearth furnace.

The Phoenix Iron Company, Phoenixville, Pa., in September, 1915, placed in operation its fourth two-ladle furnace 200 tons capacity, operating under the Maccallum patents. The hearth of this furnace is 42 ft. long and 15 ft. 9 in. wide from which the metal is tapped into two ladles through a bifurcated spout. This company is now constructing its fifth furnace of this type, which it is expected will be ready to make steel March 1, 1916. The furnaces have an average weekly output of 1000 gross tons of ingots, charging cold stock.

The Interstate Iron & Steel Company, Chicago, Ill., expects to complete early in 1916 a new plant located at Marion, Ohio. The old steel rail rerolling mill at Cambridge, Ohio, is being removed for incorporation in the new plant. This Ohio plant will consist of a continuous heating furnace, coal fired, with two trains and rolls, a 16-in., 3-stand and a 14-in., 7-stand together with all necessary equipment for finishing mills such as hot beds, shears, straighteners and traveling crane. A battery of four upright boilers, together with a waste heat boiler attached to the furnace will furnish the power. The building will be of steel construction.

The Franklin Foundry Company, Franklin, Pa., will build a new foundry in 1916 for the manufacture of steel castings.

The Pittsburgh Tool Steel Wire Company, Monaca, Pa., maker of cold drawn tool steel and drill rods, is making additions to its plant, considerably increasing the capacity.

The Pittsburgh Iron & Steel Foundry Company, Midland, Pa., increased its capacity in 1915 by the addition of a new open-hearth furnace and other equipment.

The Lima Steel Casting Company, Lima, Ohio, successor of the Crucible Castings Company, is adding to its building an extension 80 x 160 ft., in which it will install a converter in place of the present crucible process.

The Ashland Steel Company, Ashland, Ky., is planning radical improvements in its rod mill, but it is possible that these may not be started in 1916.

The Colorado Fuel & Iron Company, Pueblo, Colo., in 1915 erected an addition to its field fence building and new field fence machines for the same were purchased, the total improvements involving an outlay of $40,000.

The Standard Crucible Steel Casting Company, Milwaukee, Wis., is building an addition to its foundry and pattern shop and is about to contract for the installation of an additional furnace, 30 x 30 ft., with an 85-ft. stack.

THE STEEL CORPORATION

The marvelous expansion of the second half of 1915 made it necessary for the United States Steel Corporation to take up new construction plans on a scale unequaled since the boom of 1906. Many millions have been appropriated in the past six months for this program, of which the chief features are indicated below:

Carnegie Steel Company

This company, at its Ohio works, will build three new open-hearth furnaces, together with two pit furnaces, with the necessary equipment. Blast furnace No. 1 at the Bellaire, Ohio, works, is now under reconstruction. At the Edgar Thomson works, furnace I will be rebuilt. The plans also call for two hot stoves, the reconstruction of stockyard bunkers and larry system and installing an electric transfer system from car dumper to stockpiles at furnaces H and I. At the Homestead steel works one 1500-ton hot metal mixer at open-hearth plant No. 3 is to be built, as well as five reheating furnaces for the 84-in. plate mill. The company is building at its Clairton works 200 by-product coke ovens complete with tar and ammonia recovery plant. An additional wheel unit will be added at the Schoen steel wheel works.

Illinois Steel Company

A duplexing plant, consisting of two 100-ton open-hearth furnaces, including auxiliary equipment, and two 25-ton Bessemer converters, will be constructed at the South works at South Chicago. Improvements to No. 2 open-hearth plant, including an additional hot metal crane and additional slag-handling equipment are also to be made. Six gas-driven blowing engines will be installed at blast furnaces Nos. 1 to E.

At its Joliet works, Joliet, Ill., a benzol recovery plant is under construction at the company's by-product coke ovens.

Indiana Steel Company

This company will build in 1916 a duplexing plant consisting of two 25-ton Bessemer converters and two large tilting open-hearth furnaces with auxiliary equipment.

Four blast furnaces will be added (two in addition to the two recently announced, bringing the total to twelve), including stoves, ore bins, gas washers, gas-blowing engines, an ore bridge, and ore unloaders.

New mills under construction or to be built include a 160-in. sheared plate mill, a 40-in. two-high blooming mill, one 20-in. and two 10-in. merchant mills, as well as four 3000-kw. electric gas engine units. Waste heat boilers will be installed at open-hearth department No. 1 and two 75-kw. steam turbo-electric units.

American Steel & Wire Company

New work at this company's Donora works, Donora, Pa., include three additional 60-ton open-hearth furnaces, one 1000-ton mixer and one soaking pit. Additional rod mill capacity will also be provided. For the Newburgh steel works, Cleveland, Ohio, one additional open-hearth furnace is authorized. Improvements at the Cuyahoga works at Cleveland include a rod mill for rolling rounds and a flat mill for rolling flat rods, including heating furnaces and all auxiliary equipment. Additional buildings with wire-drawing and galvanizing equipment will also be erected. A by-product coke plant is to be a new addition at the company's Central furnaces at Cleveland.

National Tube Company

Four additional open-hearth furnaces and waste heat boilers for the entire open-hearth unit will be provided at Lorain, Ohio. A complete 40-in. blooming mill is also to be built.

American Sheet & Tin Plate Company

An extensive tin-plate plant with auxiliary equipment will be built at Gary, Ind. A sulphuric acid plant will be added at the Vandergrift, Pa., works.

Shelby Steel Tube Company

Mills A and B are to be enlarged and improved at this company's Standard works at Elwood City, Pa., extending its operations to larger sizes.

American Bridge Company

The improvements authorized for the Pencoyd, Pa., works, are the installation of 10 waste heat boilers and three 750-kw. mixed pressure turbines.

NEW ROLLING MILL WORK

The Canton Sheet Steel Company, Canton, Ohio, has under way extensions to its plant which include the installation of 9 hot mills, 5 sets of cold rolls, 2 roughing mills and the enlargement of its annealing and finishing department. When the additions are completed, which will be about Feb. 1, the company will have 12 sheet mills, 5 tin mills and a 56-in. jobbing mill, and the annual capacity of the plant will be increased to 100,000 tons. Tin products and blue annealed sheets will be added to the present line of products. An extension 420 x 170 ft. has been added to the main building to furnish space for the additional mill equipment.

The Union Rolling Mill Company, Cleveland, Ohio, enlarged its steel-making capacity during the year by the installation of a 21-in. bar mill which will be ready for operation in a few weeks. This mill is housed in a new building, 425 x 75 ft.

The Empire Rolling Mill Company, Cleveland, Ohio, has enlarged its plant and will add to its line of products by the installation of sheet mills. There are six finishing mills, and four sets of cold rolls. The equipment includes a galvanizing department, furnaces and annealing ovens. The sheet mills are housed in a new building, 504 x 145 ft., which is served by a 30-ton and two 10-ton cranes. The sheet mills will be ready for operation early in the year. The company plans eventually to roll iron sheets as well as steel sheets.

The Elyria Iron & Steel Company, Cleveland, Ohio, erected in 1915 a modern plant for the fabrication of light gage tubing, consisting of one large main building and several minor ones including a very modern oxygen plant and one for producing acetylene gas. An addition to the main building has been started, 75 x 120 feet, to store raw materials.

The McKeesport Tin Plate Company, McKeesport, Pa., is adding to its present plant of 22 mills 20 hot mills complete with all the appurtenances necessary to furnishing tin plates. An electric power plant sufficient to produce power for the 42 mills is also being built. It is hoped to have the complete plant in full operation next May.

The Trumbull Steel Company, Warren, Ohio, completed and placed in operation in 1915 8 sheet mills and 4 tin mills and recently commenced the erection of 4 sheet mills, 2 tin mills and 2 jobbing mills. When completed, these will make 32 mills in all of which 18 will be sheet mills, 12 tin mills, and 2 jobbing mills.

The Sharon Steel Hoop Company, Sharon, Pa., installed a 4-stand continuous mill in connection with its 9-in. finishing train.

The Newport Rolling Mill Company, Newport, Ky., completed in 1915 a new galvanizing works, 160 x 900 ft., built of heavy steel construction by the McClintic-Marshall Company. This plant is equipped with 8 galvanizing pots and with 20 and 10-ton Alliance cranes.

The Mansfield Sheet & Tin Plate Company, Mansfield, Ohio, recently authorized extensions that will increase the capacity of the plant about one third. One new hot mill and 4 additional cold rolls, all motor driven, will be installed as well as additional annealing furnaces. The additional equipment will be installed in a new building 140 x 240 ft.

The Cleveland Hardware Company, Cleveland, Ohio, during the year installed an electric drive for the 10-in. mill in its rolling mill department.

The Pacific Coast Steel Company, Seattle, Wash., which recently purchased the plant of the bankrupt Irondale Steel Company, Irondale, Wash., will erect a new open-hearth furnace plant with one rolling mill and the necessary buildings. The new plant will be electrically operated and the open-hearth furnaces will have a capacity of 200 tons of steel per day. Tin plate and sheet mills may be added later.

BLAST FURNACE WORK

The Thomas Iron Company, at Hokendauqua, Pa., has completed the rebuilding of its No. 3 blast furnace and installed electric power in the machine shop, doing away with the steam engine. A hot blast stove 21 x 90 ft. is nearly completed; it is a 2-pass McKee type, with Huessener gas burner. Part of the cold blast main has been rebuilt with special anchorage to prevent undue vibration, designed by Arthur G. McKee. At Alburtis, the old No. 7 furnace is being remodeled so as to have a small steel shell inside the old square stone stack. It is being equipped with two 18 x 70-ft. 2-pass brick stoves, which are being removed from the dismantled No. 6 furnace at Hokendauqua. These two

hot-blast stoves will be connected with the three present cast-iron pipe stoves which will serve as preheaters, calling for special connections for the blast entering on the cold side of the stoves. At the Saucon furnaces, at Hellertown, Pa., No. 10 furnace has been designed for half anthracite and half coke. Two new steel concrete ore trestles have been erected. A new four compartment vertical shaft at the Richard mine at Wharton, N. J., was started in August, 1915, and has been sunk over 100 ft. Prospecting for hematites in Pennsylvania was begun in September and ore bodies varying in thickness from 10 to 90 ft. have been found.

The New Jersey Zinc Company expects to increase the capacity of one of its furnaces at Palmerton from 100 to 150 tons per day, to be completed before July 1, 1916.

The Alabama Company, Birmingham, Ala., during 1915 completed the new slope at its Brookwood mine at a cost of about $60,000, installed electrical equipment at its Attalla ore mines at a cost of $1,000, and now has under construction a new opening at its Searles mine to cost about $40,000, besides additional equipment for its Attalla ore mines costing about $15,000 and repairs and additions to its Ironaton furnace plant to cost about $35,000.

The Toledo Furnace Company, Toledo, Ohio, is erecting a by-product coke plant which will consist of 96 Koppers ovens that will have sufficient capacity to supply coke for the company's two blast furnaces. It is expected that these will be ready for operation about May 1.

The Cleveland Furnace Company, Cleveland, Ohio, during 1915 installed at each of its blast furnaces a crane and grab bucket to use in connection with its chain system for handling slag and in installing a crusher, screens and steel bins for the screening and preparation of slag directly as it is produced by the furnaces. It is also replacing its wooden trestles with steel ones and is erecting 140 ft. of additional steel bins adding a transfer car on top of the bins.

The Woodward Iron Company, Woodward, Ala., intends to electrify its Songo mine in 1916, to complete the electrification of the three Woodward red ore mines and to put down, complete and electrify one new coal mine to be known as Dolomite No. 3. Work is also being started on a new deep ore slope which will require about 2½ years. About 13 miles of railroad trackage will also be put down. These improvements will involve about $500,000, a great part of which will be spread over two to three years.

The Belfont Iron Works Company, Ironton, Ohio, is installing machines in its wire plant for the manufacture of woven wire fencing and has put up a good-sized brick building. At the blast furnace a new cast house has been erected as well as an electric crane and crane runway.

The No. 5 mill of Witherbee, Sherman & Co., Inc., Port Henry, N. Y., taking the place of old Nos. 1 and 2 mills for the concentration of Old Bed ore, was finished and put in operation April 1, 1915. It has a capacity of 200 tons an hour and is built of reinforced concrete and steel. The head end of No. 2 mill has been rearranged, putting in new bins of 1200 tons' capacity and a new trestle connecting the bins with the Barton Hill mine. A new railroad extension is now being made between Cook shaft and Sherman mine, three-fourths of a mile, preparatory to opening up the Sherman mine. Another club house for employees has been furnished ready for occupancy Jan. 1, 1916. A dryer has been put in No. 3 mill for drying the ore before separation. Plans are being prepared for a new 400,000-ton dock with stock piles and rapid boat unloading equipment on the site of the old Witherbee, Sherman & Co.'s docks at Port Henry. The haulage system in the Barton Hill mine has been rearranged, three main parallel slopes equipped with large hoists and skips and large bins for transferring the ore from the slopes to the cars on the tunnel level. This mine will be put in operation Jan. 1, 1916. The rearrangement of the Old Harmony hoisting system described in THE IRON AGE June 24, 1915, was put in operation in April, 1915. Plans are under way for putting Sherman mine and Smith mine in operation early in the spring of 1916.

The Empire Steel & Iron Company, Catasauqua, Pa., in 1915 installed a storage system with traveling belt conveyors at Mt. Hope, N. J., as well as an underground blacksmith shop about 1000 ft. below the surface, where all drill sharpening is done at a great saving. A new saddle tank switching locomotive and a 20-ton locomotive crane have been purchased and the concentrating mill has been improved so that it has a capacity of approximately 20,000 tons of high-grade concentrates averaging 60 per cent. metallic iron. The blast furnace at Oxford will be rebuilt in 1916 and a new mechanical filling system with concrete bins installed. A new three-compartment shaft is being sunk at the Oxford mine which will have to go down about 1200 feet; it is about three-fourths complete. A new electric hoisting engine for this mine has been ordered. The installation of a new separating plant is contemplated, plans for which are already drawn.

A by-product coke plant consisting of Roberts ovens with a daily capacity of 440 tons is being erected by the Dover By-product Coke Company at the Dover blast furnace, Canal Dover, Ohio, controlled by M. A. Hanna interests.

The Northwestern Iron Company, Milwaukee, Wis., has built in connection with its blast furnace and by-product coke plant at Mayville, Wis., a benzol plant. It was placed in operation last May.

Zenith Furnace Company, Duluth, Minn., built in 1915 a benzol plant to absorb the by-product output of its coke ovens.

During 1915 No. 2 blast furnace of the Andrews & Hitchcock Iron Company, Youngstown, Ohio, was completely rebuilt, enlarged and put in operation last August. It has a capacity of about 450 tons a day. The stack was relined and one new stove added. Two blowing engines furnished by the Mesta Machine Company, Pittsburgh, were installed, and a good deal of the old plate work was replaced. New ore storage bins were also erected. In 1916 No. 1 furnace of this company will also probably be rebuilt, conforming in size and capacity to No. 2 stack.

NEW CANADIAN CONSTRUCTION

The Steel Company of Canada, Ltd., of Hamilton, will build three 50-ton open-hearth furnaces in 1916, the contract for which has been given to Alex Laughlin & Co., Pittsburgh. These will be placed in a building to be erected by the Hamilton Bridge Works Company of Hamilton, large enough to house an additional furnace later. The company is doubling its soaking pit capacity for the blooming mill, erecting the necessary building for this.

The Canadian Steel Foundries, Ltd., of Montreal, has added one 30-ton acid open-hearth furnace at its Longue Pointe Works, and is preparing to erect others in the very near future.

The Canada Cement Company, Ltd., Herald Building, Montreal, Canada, has begun the erection of an open-hearth steel furnace and an electric furnace. The building to house these furnaces will be steel and corrugated iron construction.

Pittsburgh and Nearby Districts

The Brier Hill Steel Company, Youngstown, Ohio, retired Jan. 1 a block of bonds amounting to $125,000, issued by the Empire Iron & Steel Company before that corporation was absorbed. The $2,000,000 bond issue of Feb. 1, 1915, is now the only outstanding obligation of the kind carried by the Brier Hill Company, as it has retired $50,000 of bonded debt of the Thomas Steel Company, incurred before its absorption.

The C. C. & E. P. Townsend Company, New Brighton, Pa., announces that Jan. 1 it changed its name to Townsend Company. With the arrival of the year 1916 it completed a century of business in the manufacture of rivets, nails, wire and wire products, claiming to be the oldest wire mill in America. Beginning as R. Townsend & Co. in 1816, changes in name occurred as follows: W. P. Townsend & Co., 1864; C. C. & E. P. Townsend, 1894; C. C. & E. P. Townsend Company, 1905; Townsend Company, 1916.

The Brier Hill Steel Company, Youngstown, Ohio, has placed a contract with the H. Koppers Company, First National Bank Building, Pittsburgh, for the erection of 84 Koppers by-product coke ovens. It is not yet decided whether benzol apparatus will be included. Work will be started at once, and the ovens are expected to be finished about Dec. 1, 1916.

On Saturday, Jan. 15, the Carbon Steel Company, Pittsburgh, will pay out about $50,000 as a bonus to its employees, representing about 10 per cent of the wages they earned in the very active period from August to December. It has also agreed to pay a bonus of 10 per cent of wages earned by its employees in the first six months of 1916. The company is operating its plant to full capacity.

New Heroult Electric Furnaces

The United States Steel Corporation announces the granting of five licenses for the installation of Heroult electric furnaces since Nov. 25, when the last list was published in THE IRON AGE. They are as follows:

Harrow Spring Company, Kalamazoo, Mich., one 6-ton furnace.

Union Spring & Mfg. Company, New Kensington, Pa., one 6-ton furnace.

International High Speed Steel Company, Rockaway, N. J., one 6-ton furnace.

Electric Steel & Metals Company, Ltd., Welland, Ont., one 6-ton in addition to the 6-ton recently ordered.

Halcomb Steel Company, Syracuse, N. Y., one 6-ton in addition to the one which it has operated for a number of years.

These five furnaces bring the total to forty-three in this country and Canada.

New Machinery Company at Duluth

The Waldron-Woodbridge Company is the name of a new machinery selling organization formed at Duluth, Minn., by Fred H. Waldron and Roger M. Woodbridge. The company's sales, since organizing a month or six weeks ago, give promise of a most successful career. It represents the Chicago Pneumatic Tool Company and the Deister Concentrator Company, and negotiations are under way for connections with other well-known manufacturers. Mr. Waldron is a graduate of Sheffield Scientific School, Yale University, and Mr. Woodbridge is a son of Dwight E. Woodbridge, the mining engineer. Mr. Woodbridge of the new company has been working in and about mines for some years, both as a student and in actual practice.

The William Bingham Company, wholesale hardware merchant, Cleveland, Ohio, has moved into its new warehouse on West Ninth Street, an 11-story building providing 15 acres of floor space. The company will now carry a much more complete line of steel mill products, ample room being provided for a large stock. With the removal to its new quarters the company discontinued its retail hardware business, which it had conducted since 1841.

Annual Capacity of Heroult Electric Steel Furnaces in All Countries

An interesting comparison has been compiled by the United States Steel Corporation showing the standing of the various countries as regards the capacity of the Heroult electric steel furnaces operating or contracted for. The increased capacity in 1915 is also given. The table is as follows:

	Annual Capacity, Metric Tons		Increase in 1915, Metric Tons	Furnaces
	1914	1915		
United States	141,200	371,500	230,300	40
Germany	385,750	403,750	18,000	17
England	77,000	189,800	112,800	20
Canada	6,000	21,600	15,600	3
France	194,500	234,800	40,300	11
Belgium	30,000	30,000	.....	2
Luxemburg	40,000	43,600	3,600	2
Austria-Hungary	61,500	74,100	12,600	10
Switzerland	2,500	2,500	.....	1
Italy	41,000	54,000	13,000	4
Russia	30,000	30,000	.....	3
Sweden	6,000	14,700	8,700	2
Total	1,015,450	1,470,350	454,900	115

In increased tonnage in 1915 the Heroult furnaces of the United States lead with 230,300 tons, which is over half of the increase for the world. In total capacity Germany is first, with 403,750 tons, or 32,250 tons greater than the total for this country. However, if the large 30-ton furnace of the Dortmund Union at Dortmund, Germany, with a yearly capacity of 120,000 tons be eliminated, the United States would easily rank first in Heroult tonnage capacity. This furnace was listed as contracted for a year ago and has not been reported as active yet and may not be operated for some time. The marked increase in England's Heroult capacity is to be noted—112,800 tons in 1915. With the ten new Grönwall furnaces in England in 1915 as well as the three Snyder, one Rennerfelt and one Wile, England is fast assuming a leading rôle in electric steel tonnage capacity.

Iron-Ore Imports for Eastern Furnaces in 1915

As heretofore the principal importers of iron ore in Eastern districts in 1915 were the Pennsylvania Steel Company, its subsidiary the Maryland Steel Company, and the Bethlehem Steel Company. The Government figures for the year's imports have not yet been made up, but up to Oct. 1, 1915, these showed importations of 32,946 tons from Spain and 48,235 tons from Canada. No Wabana ore has been received this year from Newfoundland.

The Bethlehem Steel Company's imports for 1915 amounted to 139,110 tons from its Tofo mines in Chile; 207,329 tons from Sweden under the company's ten-year contract, and 215,032 tons from its Juragua Iron Company mines in Cuba.

The Spanish-American Iron Company, which carries on the Cuban iron mining operations of the Pennsylvania Steel Company, made shipments from Cuba in 1915 as follows: From Daiquiri, 245,088 tons; from Felton, the shipping port of the Mayari district, 296,407 tons of nodules and 4617 tons of raw ore. The shipments of iron ore by the Ponupo Manganese Company from its iron mines at El Cuero, Cuba, in 1915 were 65,930 tons. The Cauto Mining Company shipped about 6000 tons of manganese ore from Cuba. It would thus appear that the total of imports of iron ore to the United States in 1915 was 1,300,000 tons, or practically the same as in 1914.

Advance to Cleveland Molders

A wage agreement has been made between foundrymen operating heavy shops in Cleveland, Ohio, and their molders. Under the terms of this agreement the molders will get an advance from the present rate of $3.50 per day to $3.85 for three months and after that for a period of nine months an advance to $4 per day. The agreement covers a period of one year and affects about 25 shops and approximately 1200 men.

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EDITORS:
A. I. FINDLEY
GEO. W. COPE W. W. MACON
CHARLES S. BAUR, *Advertising Manager*

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A Sixtieth Anniversary

Sixty years ago, in the summer of 1855, the first issue of what is now THE IRON AGE came from the press. Started at Middletown, N. Y., as the *Hardware Man's Newspaper*, it was first known as THE IRON AGE in April, 1859. For fifty years thereafter the iron and steel and hardware trades were represented by this journal, for most of that period a distinct hardware department being maintained, having its own editorial staff. Six years ago it was decided that the hardware merchant interests could best be served by a separate journal, and thereupon began the vigorous career of the *Hardware Age*, which to-day, with the same publishers, is successfully working out its destiny alongside THE IRON AGE.

The beginnings of THE IRON AGE were contemporaneous with the beginnings of the greatest development of the material arts the world has ever seen. Some of the steps in this marvelous progress in invention and industry are summarized and graphically portrayed on other pages. The contrasts thus shown between the instruments of production and the mechanical products of 1855 and 1915 represent but one phase of the advance of a span of sixty years that set the world farther forward than all the centuries that preceded them.

Trade and technical journalism was a development of the years after the Civil War, which saw such prodigious expansion in American manufacture and railroad building. THE IRON AGE was thus the advance guard of the pioneers in business journalism. "We entered upon a wholly new field and did not take for our pattern or example any existing publication," wrote its publishers some years after 1855, when the success of the venture had been proved. Chief among the aims of the founders, as set forth in their reviews of the early years, were to make THE IRON AGE "interesting, trustworthy and thorough," and those words, while not all-inclusive, might well stand for the main aims of their successors. Sixty years ago the manufacture of iron and steel in this country was so limited that American consumers drew the bulk of their supplies from foreign sources. It was very definitely in the plans of the founders of THE IRON AGE to work for American independence of British manufacturers, and it is only recording a fact of history to say without amplification that this journal has greatly assisted in the development of iron making and iron working in the United States.

It is no part of the present purpose to recount the steps by which THE IRON AGE has come to the place it holds to-day as a journal of iron and steel, machinery and the manifold lines of metal-working. The personal factor is often made prominent in such a retrospect. But that may well be passed by at this time to give emphasis to the part the great industries it represents have had in making THE IRON AGE so unique an institution. If the paper has built itself into the iron and steel and machinery trades, it is also true that these great industries and the men of vision and venture who have brought them to such high development have also built themselves into THE IRON AGE. That it has recorded and commented upon the achievements of so eminent a constituency has been to those responsible for its conduct a constant spur to enthusiasm and enterprise.

On the rare anniversary occasions on which the publishers have given some account of the paper's progress, they have not failed to say that the success of THE IRON AGE was due from the beginning to the fact that their first concern was to make it of value to its readers. Many trade journals have sprung up in these sixty years in some portion of the same field, but most of them have disappeared, and the passing of nearly all can be attributed to their policy of making the interests of readers subordinate to the interests of advertisers. The gains of THE IRON AGE in the subscription field and those in the advertising field have steadily reacted one upon the other until to-day it stands at high mark both in number of readers in the iron and steel and metal-working trades and in the number and representative character of the firms and corporations using it as a medium of trade promotion.

The march of the American iron trade in the sixty years in which this journal has kept it company has taken both over many a rough way, in the alternation of prosperity and adversity. The last third of the journey has brought many and momentous changes. The equipment for success in the competitions of modern steel and machinery manufacture is on a scale, both in financial resources and in the human power factor, far beyond anything dreamed of even 20 years ago. Iron trade journalism and its demands upon those who follow it have likewise expanded. Taking the single matter of

mechanical requirements, standards have risen by leaps and bounds. The advance in type and engraving has been so great that what satisfied IRON AGE readers ten years ago would not be tolerated to-day. Comparing this issue in typography and illustration with one of five years or even three years ago, the improvement has been marked.

In respect to amount and character of reading matter the demands of the time have also increased, as emphasis has been put more and more upon the manufacturer's problems of management, of intensive production, of international markets and of adjustment to rapid economic and political changes. In the present issue of THE IRON AGE the idea of marking its sixtieth anniversary has been quite incidental to the purpose of this and the other Annual Review numbers that have appeared at the openings of recent years. All have been striking exhibits of progress in the country's greatest industry save only agriculture. There is a peculiar fitness, however, in linking up to-day's issue with the first number of the four-page paper printed at Middletown, N. Y., sixty years ago. That was a prophecy of an American iron industry which should free the United States from its long dependence upon Europe. This is the chronicle of a year, standing at the head of a long line of wonderful years in iron and steel, in which that same home industry, a hundred fold greater than in 1855, sent to Europe and the rest of the world more of its products than in any year of its history and laid the foundations for a large and increasing trade in the markets of the world.

Railroads and Shipyards as Consumers

Two important interests promise to consume much larger quantities of steel products in 1916 than for several years. One of these is the railroads and the other the shipyards. Both have greatly increased their activities, entering upon an era, which it is hoped may long be continued, of full employment of facilities and greatly improved earnings.

The railroad companies are not only enjoying largely increased traffic, but they are also reaping the benefit of the improvement made in their efficiency of operation brought about in the protracted period of stress. Now that their gross earnings have turned the corner and are again moving upward, the ratio of net earnings is making a most favorable comparison with corresponding periods in previous years. The railroads, like the steel industry, were first stimulated by the European war, but they are now also transporting much more domestic business, partly due to the large crops of last season and partly to the revival of general industry. They have received some benefit from increased rates. The increases have not been large, but, coming at the time they did, they materially helped to swell the gross earnings. The very fact that at last the Interstate Commerce Commission has recognized the needs of the railroads, by giving them the opportunity to secure greater earnings, has given the public more confidence in railroad securities. The country has for a long time been going through a period of under-development in railroad extension, and possibly from this time forward the capital may be more easily forthcoming for the construction of new roads, badly needed in certain sections of the country, and for the improvement of facilities which the traffic congestion of the past few months has shown to be greatly wanted.

A cataclysm in the world's shipping trade has been necessary to bring about the great activity now prevailing in our shipyards. Every American plant capable of building vessels is now taxed to its capacity. We are not only building ships for our own people, but for other nations. Plants that had been practically abandoned are being overhauled and put in readiness for operation. Offerings of new contracts for steamships are steadily developing, so that for a long time to come whenever a launch leaves a berth vacant it will immediately receive the keel of another ship. The scarcity of ocean steamships and the very lucrative freight rates now being obtained have suddenly brought American shipping out of its long sleep into the bright sunlight of activity and prosperity. The European war has thus precipitated the desirable conditions which American publicists and statesmen have been for years trying to devise a method to accomplish.

The railroads have always been heavy consumers of iron and steel in normal times. Our shipyards have long been a negligible quantity, but they have always contained the germ of large consumption if the conditions should permit its development. Both interests are now making their influence felt in the iron and steel trade, and as the year progresses it is to be expected that their ability to take part of the products of our steel mills will become continuously greater.

The Railroads' Showing in 1915

The statistics gathered annually by the *Railway Age Gazette* furnish a very accurate index of conditions with the railroads. As to their financial condition, 20,143 miles of road went into the hands of receivers during 1915, or as much mileage as in the five preceding years taken together, and the largest for any year in forty, barring 1893. Prior to the recently terminated Wabash receivership, involving 2514 miles, there was 42,000 miles of road in receivers' hands, the largest total in the history of American railroading.

As to railroad expenditures, the new line completed in 1915 amounted to 933 miles, one-fourth the average amount in the ten years preceding, and the smallest since the period of the Civil War. Passenger cars ordered amounted to 3092, fully equal to the average in preceding years. Freight cars ordered totaled 107,796, or 70 per cent of the average of the seven preceding years, following the heavy buying of 1905-6-7. There were 1573 locomotives ordered, rating at 54 per cent of the average for the same seven years. It may be mentioned that car and locomotive shops are busier at this time than would be suggested by these statistics, partly because the buying has been chiefly in the past few months, and partly because relatively large export orders have been taken.

While the purchases of rolling stock have not been large by any means, the showing as to equip-

ment purchases is much more favorable, or much less unfavorable, than the showing of many receiverships and scarcely any new building of road. The information furnished by our railroad contemporary confirms the view commonly entertained that capital is averse to going into railroading, but that the railroads, being busy, are forced to buy equipment and keep up their lines as well as they can.

If the iron and steel industry had not furnished the lure of possible large profits it would not have expanded as it has. If progress had not been in the atmosphere, moving existing concerns to expand, to outdo their competitors, perhaps, but at any rate to be prepared for increased future demand, the steel industry might indeed have grown, but the growth would have had to be forced by there being periods of acute scarcity of material, during which periods the consuming industries would have been greatly hampered. The railroads have lately not had the inducements suggested.

The railroad outlook, however, is not as bad as appears merely from the statistical record of the immediate past. Railroad expansion at the moment is naturally not in keeping with the volume of traffic or the monthly earnings of the roads, for this is a war time, the war condition making business, but at the same time causing capital to be relatively timid. Then the rapid development of the trolley line has been a deterrent to steam road expansion in recent years. Eventually the proper relationships will undoubtedly be established and then development will proceed in more orderly manner. Finally, it requires no optimistic spirit to observe that the attitude of the public and of government authorities toward the railroads has lately become much more favorable. Undoubtedly much more encouragement is going to be given the railroads to expand. They have probably already seen their darkest days.

Youngstown Sheet & Tube Profit Sharing

The Youngstown Sheet & Tube Company, Youngstown, Ohio, has announced a profit-sharing distribution of 5 per cent of the earnings of its employees eligible under its profit-sharing plan during the year 1915. The amount distributed will be approximately $350,000. About 9000 men are affected. This profit-sharing plan, which is the only cash distribution system in effect by any steel corporation in the Youngstown district, has been in operation since 1909, being one of the first established in this country. In 1910 the first distribution of 5 per cent was paid. In 1913 the distribution was 6 per cent and in 1914 was 3 per cent. The distribution authorized for 1915 will be made as soon as the clerical work can be completed, probably the second pay period in March. This distribution is of special interest because the company has appropriated in the past year about $8,000,000 for extensions.

The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has taken orders for a car dumper for the Chile Exploration Company, a Guggenheim interest; a car dumper for the Delaware, Lackawanna & Western Railroad for handling anthracite coal at Buffalo, and four gas producers, together with a producer building and coal and ash handling equipment, for the Imperial Steel Works of Japan.

The Herrmann Gehnrich Company, 52 Franklin Avenue, Brooklyn, N. Y., has changed its name to Gehnrich Indirect Heat Oven Company, Inc.

THE TOOL-STEEL TRADE

Change of Conditions in 1915 and Outlook for This Year

Conditions as they existed in the tool-steel trade, particularly in high-speed tool steels, in the first part of 1915 as compared with the last four or five months of the year could hardly have shown a greater contrast. In the first months of 1915, or until May, the demand for tool steels was only moderate, none of the plants running to full capacity, and prices ruling low. The tool steel trade had not yet commenced to feel the impetus of the demand for machine tools and for war munitions. Early in May the increase began, and from that time until the close of the year, demand was beyond the capacity of the mills to furnish promptly, and prices advanced to very high levels.

The important element of high-speed steels is tungsten, which is obtained from Wolfram ore found mostly in India; much of it used to come to this country through the port of Hamburg, Germany. By the war this source of supply was cut off, and to make the situation worse, the British Government placed an absolute embargo on tungsten from England and her colonies. It is said England controls 50 per cent of the output of tungsten of the entire world, and it thus became difficult for tool-steel makers to obtain a supply of ferrotungsten to take care of domestic orders. On account of the tremendous increase in prices of tungsten, there has been a good deal of new development, mostly in Colorado and adjacent States, but so far the amount of tungsten that has been found and made ready for the open market is relatively small.

Two years ago imported tungsten sold as low in this country as 65c. per pound of pure contained tungsten, but at the present time it is selling from $7 to $8.50 per pound. The call for high-speed tool steels was increased to some extent by war contracts for munitions, but the greater increase came from regular domestic consumers, notably the builders of machine tools. Some makers of high-speed steel state that for more than six months the demands on them for tool steel have been three or four times greater than they were able to supply. The scarcity of tungsten prevented them from operating at times to full capacity, though it is believed there is sufficient tool-steel capacity in this country to take care of the demand under normal conditions.

INCREASED TOOL-STEEL-MAKING CAPACITY

There was no notable increase in capacity for making tool steel in 1915, but there will probably be one or two new plants started during 1916. The Crucible Steel Company of America has a new tool-steel plant under construction at Syracuse, N. Y., to be operated under the name of the Syracuse Crucible Steel Company, but there is nothing on the ground so far but the buildings.

Prices of steel scrap used in making high-speed steels increased enormously during the year, and are now six or seven times what they were a year ago. On account of the very high prices and inability of consumers to get high-speed tool steels, promptly, some resorted to the use of carbon steels and air-hardening steels and are still doing so. At the present time prices of high-speed tool steels are five to six times greater than they were a year ago. Regular grades of tool steel are selling at 8½ to 9 cents; extra grades, 15 cents to 17 cents; special grades, 20 to 25 cents, and special steels, carrying alloys, at very much higher prices. High-speed tool steels are selling at $2.80 to $3 per pound. All the above prices are f.o.b. maker's mill, and all carry classifications and regular extras. Some high-speed steels have been marketed containing less than the regular amount of tungsten.

At the present time makers of tool steels are crowded with orders for months ahead, and in many cases, have asked customers either to cancel orders already taken, or to cut down one-half or more the amount of steel called for in their contracts. Tool-

steel makers say the outlook for 1916 is excellent, and all indications are that present abnormal conditions in the trade, both as regards the enormous demand and high price levels, are practically certain to continue through the year of 1916.

MANY LAKE VESSELS BOUGHT

Additions to Steel Corporation Fleet—Boats for the New Steel Combine?

The Interlake Steamship Company, controlled and operated by Pickands, Mather & Co., late last week purchased the lake vessels of the Cleveland Steamship Company, known as the Mitchell fleet, consisting of thirteen boats. The price paid was $3,047,000. This is the largest lake boat sale since the buying of vessels by shippers and consuming interests started in October; in fact, the largest lake vessel merger since the Pittsburgh Steamship Company was formed. With the acquisition of the Mitchell boats the Interlake fleet in the coming season will consist of fifty-two boats, fifty steamers and two barges, being exceeded in size both in number of vessels and tonnage only by the fleet of the Pittsburgh Steamship Company. With a 12,000-ton boat now being built, the Interlake Steamship Company will have a carrying capacity of more than 7,000,000 tons per season, of which the Mitchell fleet represents about 1,900,000 tons. It is reported that a deal is pending for the sale of the Interlake fleet to a proposed independent steel company to be formed by the merger of the Youngstown Sheet & Tube Company, the Cambria Steel Company, and the Lackawanna Steel Company, although this has no official confirmation. Capt. John Mitchell, who has been at the head of the Cleveland Steamship Company since its organization, will not retire from the lake vessel business with which he has been prominently identified for over forty years, but will remain active as manager of the Buffalo Steamship Company and the Gratwick Steamship Company.

The greatest change in the history of the lake trade has occurred since the shippers and consuming interests began a few months ago to buy up the independent vessel property, the purchase of boats being greatly stimulated since by the inability of ore shippers and consumers to secure season charters of sufficient vessel capacity for carrying ore during the coming season and the possibility of a shortage in boats because of the expected very heavy movement. In the past three months fifteen independent owners sold all their vessel property, and boats of some other fleets changed hands. During that period over fifty lake boats having a capacity of over 7,000,000 tons a season have been sold, more than $11,000,000 being involved in these transactions. Among the latest purchases are five boats with a carrying capacity of 38,000 tons a trip by Oglebay, Norton & Co., and Capt. W. C. Richardson. These will be managed by W. C. Richardson & Co., and will carry ore for Oglebay, Norton & Co. Another late purchase is that of the Hawgood fleet consisting of six vessels by J. C. Wallace as agent, for the Pittsburgh Steamship Company. These were operated under the name of the Acme Steamship Company. With this addition, the Pittsburgh Steamship Company will have in the coming season 102 vessels—eighty-one steamers and twenty-one barges. In the number are three 12,000-ton vessels now being built for the company.

At present seven 12,000-ton vessels and one of 9500 tons are under contract for delivery to lake owners in the season of 1916. Lake shipyards are filled up with boats for 1916, and some orders have been placed for vessels for 1917 delivery.

The biggest industrial, civic and mercantile exposition ever held in Dayton, Ohio, will open Jan. 14 and continue through Jan. 22. It will be held in the new Delco Building now nearing completion, which is a seven-story concrete structure being built by the Dayton Engineering Laboratories Company. The purpose of the exposition will be to display goods made and sold in Dayton.

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The Cleveland Chain & Mfg. Company, Cleveland, Ohio, has purchased the chain-making plant of the Krein Mfg. Company, Wapakoneta, Ohio, and will operate it as a subsidiary under the name of the Krein Chain Company. It became so crowded with orders that it was necessary to provide further capacity, and for this reason acquired the Krein plant. The products at this plant will include wagon chain, harness chain, bright and coil chain. The plants of the Cleveland Chain & Mfg. Company and its allied interest, David Round & Son, are now combined at the quarters of the former, the removal of the office and some of the equipment of the Round plant having been effected in the past few days. The business will be conducted under both names as heretofore.

The Fitzsimmons Steel Products Company, Park Street, between Fifth and Sixth avenues, Milwaukee, Wis., will erect a plant for the manufacture of drawn steel. The main building will be of concrete, brick and steel, 105 x 199.11 ft. Herman J. Esser, 402 Camp Building, Milwaukee, is the architect. The initial investment will be about $75,000. Carl and Ernst Prinz, Milwaukee, are the principal local stockholders.

PIG-IRON OUTPUT GROWS

Daily Increase in December 2100 Tons

Merchant Furnaces Make Larger Gain—Eight More Stacks Active

The last month of 1915 established a new rate of pig-iron production with a total of 3,203,322 gross tons, or 103,333 tons a day, against 3,037,308 tons in the 30 days of November, or 101,244 tons a day. More than three-fourths of the December gain of 2100 tons a day was made by the merchant furnaces. There was a net gain of 8 in active furnaces last month and on Jan. 1 295 coke furnaces were producing at the rate of 105,400 tons a day, against 103,032 tons a day for 287 furnaces one month previous. Pig-iron production is now proceeding at the rate of 38,800,000 tons a year and several more furnaces are scheduled to go in this month.

DAILY RATE OF PRODUCTION

The daily rate of production of coke and anthracite pig iron by months, from December, 1914, is as follows:

Daily Rate of Pig-Iron Production by Months—Gross Tons

	Steel works	Merchant	Total
December, 1914	33,381	15,515	48,896
January, 1915	35,998	15,661	51,659
February	44,192	15,621	59,813
March	50,036	16,539	66,575
April	52,804	17,746	70,550
May	54,655	18,360	73,015
June	59,022	20,339	79,361
July	62,895	19,796	82,691
August	67,801	21,865	89,666
September	70,977	24,108	95,085
October	73,595	27,227	100,822
November	73,282	27,962	101,244
December	73,647	29,686	103,333

OUTPUT BY DISTRICTS

The accompanying table gives the production of all coke and anthracite furnaces in December and the three months preceding:

Monthly Pig-Iron Production—Gross Tons

	Sept. (30 days)	Oct. (31 days)	Nov. (30 days)	Dec. (31 days)
New York	190,449	195,852	186,758	193,818
New Jersey	6,232	3,703	6,022	5,169
Lehigh Valley	100,714	116,086	113,904	108,862
Schuylkill Valley	64,988	85,028	79,590	92,391
Lower Susquehanna and Lebanon Valley	35,294	56,702	54,557	60,785
Pittsburgh district	700,248	773,715	730,515	750,186
Shenango Valley	144,224	169,294	171,685	190,807
Western Pennsylvania	164,596	173,428	172,290	177,002
Maryland, Virginia and Kentucky	60,247	70,946	74,816	86,448
Wheeling district	114,031	116,763	114,798	117,202
Mahoning Valley	305,564	315,399	304,421	320,196
Central and Northern Ohio	214,452	240,979	246,826	254,542
Hocking Valley and Hanging Rock	33,072	47,648	41,548	39,310
Chicago district	436,794	450,978	433,184	459,524
Mich., Minn., Mo., Wis. and Col.	75,731	79,810	81,493	97,087
Alabama	190,676	212,733	211,127	228,697
Tennessee	15,249	16,427	13,774	21,296
Total	2,852,561	3,125,491	3,037,308	3,203,322

PRODUCTION OF STEEL COMPANIES

Returns from all furnaces of the United States Steel Corporation and the various independent steel companies show the following totals of product month by month. Only steel-making iron is included in the figures below, together with ferromanganese and spiegeleisen. These last, while stated separately, are also included in the columns of "total production."

Production of Steel Companies—Gross Tons

	Pig, total production			Spiegeleisen and ferromanganese		
	1913	1914	1915	1913	1914	1915
Jan.	1,981,560	1,261,430	1,115,944	15,633	17,325	18,041
Feb.	1,792,154	1,329,414	1,237,380	20,131	10,524	13,319
Mar.	1,904,878	1,704,688	1,551,082	20,546	20,133	12,274
Apr.	1,939,751	1,635,226	1,584,111	23,108	18,676	12,337
May	1,991,192	1,457,847	1,694,290	19,042	21,504	13,440
June	1,860,070	1,329,623	1,770,657	19,212	16,254	19,200
July	1,840,216	1,395,851	1,949,750	28,310	16,524	17,854
Aug.	1,833,352	1,455,054	2,101,818	20,680	11,577	27,463
Sept.	1,828,232	1,390,322	2,129,322	24,555	13,786	23,159
Oct.	1,848,634	1,271,820	2,281,456	19,499	17,435	23,992
Nov.	1,573,007	1,059,159	2,198,459	26,765	21,977	28,741
Dec.	1,298,262	1,034,802	2,283,047	14,095	20,733	25,004

CAPACITY IN BLAST JAN. 1 AND DEC. 1

The following table shows the daily capacity in gross tons of furnaces in blast Jan. 1 and Dec. 1 by districts:

Coke and Anthracite Furnaces in Blast

Location of furnaces	Total number of stacks	Jan. 1 Number in blast	Jan. 1 Capacity per day	Dec. 1 Number in blast	Dec. 1 Capacity per day
New York:					
Buffalo	19	15	5,622	15	5,459
Other New York	7	3	634	3	646
New Jersey	7	1	167	1	201
Pennsylvania:					
Lehigh Valley	21	13	3,376	12	3,515
Spiegel	2	2	214	2	217
Schuylkill Val.	15	10	2,922	9	2,845
Lower Susquehanna	7	5	1,368	4	1,262
Lebanon Valley	10	5	775	4	650
Pittsburgh Dist.	52	49	23,830	49	23,977
Ferro	4	3	369	3	340
Shenango Val.	19	17	5,821	19	5,940
Western Pa.	23	16	5,579	16	5,594
Ferro	2	2	131	2	160
Maryland	4	3	1,265	3	1,060
Wheeling Dist.	11	10	3,781	10	3,827
Ohio:					
Mahoning Val.	25	23	10,688	22	10,147
Central and Northern	24	22	8,711	21	8,270
Hocking Val. & Hanging Rk.	15	11	1,482	10	1,591
Illinois and Ind.	35	31	15,927	29	14,471
Ferro	1	0	0	1	122
Michigan, Wis. & Minn.	11	9	2,366	9	2,475
Col. and Mo.	7	2	766	2	742
The South:					
Virginia	24	7	967	7	964
Kentucky	5	3	556	3	605
Alabama	45	25	7,268	25	7,378
Ferro	1	1	93	1	80
Tennessee	20	7	722	5	495
Total	416	295	105,400	287	103,033

DIAGRAM OF PIG-IRON PRODUCTION AND PRICES

The fluctuations in pig-iron production from January, 1908, to the present time are shown in the accompanying chart. The figures represented by the heavy lines are those of daily average production, by months, of coke and anthracite iron. The two other curves on the chart represent monthly average prices of Southern No. 2 foundry pig iron at Cincinnati and of local No. 2 foundry iron at furnace at Chicago. They are based on the weekly market quotations of THE IRON AGE. The figures for daily average production, beginning January, 1908, are as follows:

Daily Average Production of Coke and Anthracite Pig Iron in the United States by Months Since Jan. 1, 1908—Gross Tons

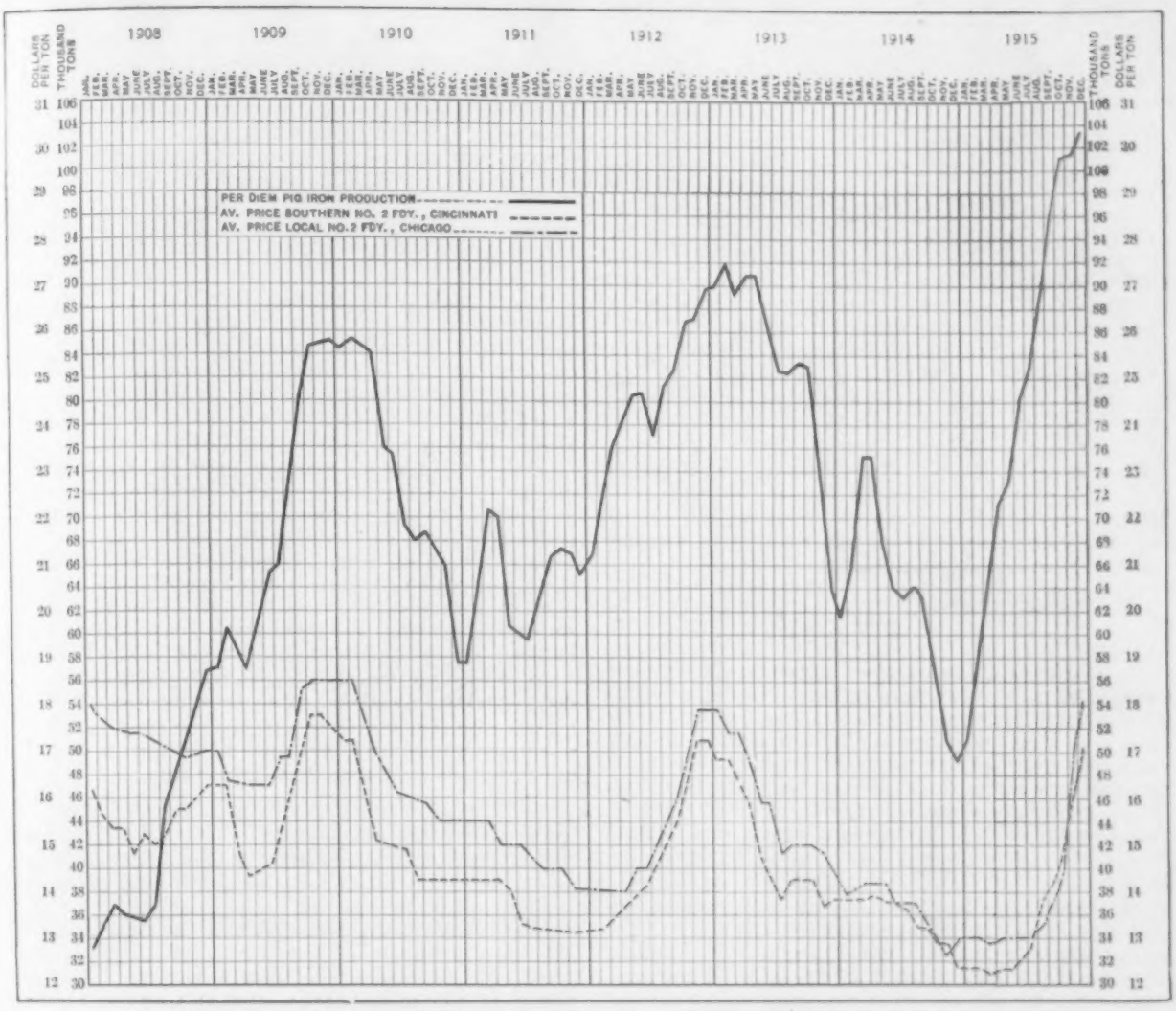
	1908	1909	1910	1911	1912	1913	1914	1915
Jan.	33,918	57,975	84,148	56,752	66,384	90,172	60,808	51,659
Feb.	37,163	60,976	85,616	64,090	72,442	92,369	67,453	59,813
Mar.	39,619	59,232	84,459	70,036	77,591	89,147	75,738	66,575
Apr.	38,289	57,962	82,792	68,836	79,181	91,759	75,665	70,550
May	37,603	60,753	77,102	61,079	81,051	91,039	67,506	73,015
June	36,444	64,656	75,516	59,585	81,358	87,619	63,916	79,361
July	39,287	67,793	69,305	57,841	77,738	82,601	63,150	82,691
Aug.	42,851	72,546	67,963	62,150	81,046	82,057	64,363	89,666
Sept.	47,300	79,507	68,476	65,903	82,128	83,531	62,753	95,085
Oct.	50,554	83,856	67,520	67,811	86,722	82,133	57,361	100,822
Nov.	51,595	84,917	63,659	66,648	87,697	74,453	50,611	101,244
Dec.	56,158	85,022	57,349	65,912	89,766	63,987	48,896	103,333

THE RECORD OF PRODUCTION

Production of Coke and Anthracite Pig Iron in the United States by Months Since Jan. 1, 1911—Gross Tons

	1911	1912	1913	1914	1915
Jan.	1,759,326	2,057,911	2,795,331	1,885,054	1,601,421
Feb.	1,794,509	2,100,815	2,586,337	1,888,670	1,674,771
Mar.	2,171,111	2,405,318	2,763,563	2,347,867	2,063,834
Apr.	2,064,086	2,375,436	2,752,761	2,269,655	2,116,494
May	1,893,456	2,512,582	2,822,217	2,092,686	2,263,470
June	1,787,566	2,440,745	2,628,565	1,917,783	2,380,827
July	1,793,068	2,410,889	2,560,646	1,957,645	2,563,420
Aug.	1,926,637	2,512,431	2,545,763	1,995,261	2,779,647
Sept.	1,997,102	2,463,839	2,505,927	1,882,577	2,852,561
Oct.	2,102,147	2,689,933	2,546,261	1,778,186	3,125,491
Nov.	1,999,433	2,630,854	2,233,123	1,518,316	3,037,308
Dec.	2,043,270	2,782,737	1,983,607	1,515,752	3,203,322
Total, yr.	23,331,711	29,383,490	30,724,101	23,049,752	29,662,566

Furnaces blown in in December include Crumwold in the Lehigh Valley, Topton in the Schuylkill Valley, one Steelton in the lower Susquehanna Valley, one Bird Coleman in the Lebanon Valley, one Hubbard in the Mahoning Valley, one National Tube stack in northern Ohio, Sarah in the Hanging Rock district, one Federal and one Joliet in the Chicago district and Chattanooga and Standard in Tennessee.



New High Mark in American Pig-Iron Output—A Daily Rate of 103,333 Gross Tons

Diagram of Daily Average Production by Months of Coke and Anthracite Pig Iron in the United States from Jan. 1, 1908, to Jan. 1, 1916; Also of Monthly Average Prices of Southern No. 2 Foundry Iron at Cincinnati and Local No. 2, Foundry Iron at Chicago District Furnace

The furnaces blown out last month or on Jan. 1 were Alice and Sharon in the Shenango Valley, and one South Chicago in the Chicago district.

Blast Furnace Notes

Out of the Carnegie Steel Company's 58 blast furnaces only nine were idle on Jan. 1, these being two Edgar Thomson stacks, which are being relined and repaired, and may go in this month; Sharon stack, which blew out on Jan. 1 for relining and repairs; Zanesville and Niles, both of which have been out for some years; one Bellaire stack, which is being entirely rebuilt; Steubenville, Edith and Neville Island. Neville Island is scheduled to go in on Thursday, Jan. 6, after an idleness of over three years, and Edith a week or 10 days later. Neville Island will make about 500 tons a day and Edith 300 tons.

It is expected that work on the new 500-ton blast furnace to be built at the plant of the Worth Brothers Company, Coatesville, Pa., will begin in the spring. The company has two 450-ton furnaces, one of which is in operation. The other is undergoing repairs and is expected to be put in blast within two weeks, after being idle for almost two years.

The Marshall furnace of the Juniata Furnace & Foundry Company, Newport, Pa., will go in blast about Jan. 15 on spiegeleisen. R. M. Marshall is manager.

Watts furnace of the Virginia Iron, Coal & Coke Company at Middlesbrough, Ky., is now being repaired and will probably go in blast Feb. 1.

Negotiations are pending whereby the long-idle blast furnace of the Woodstock Iron Company in Anniston may be put in blast. This prospect is connected with the proposed ordnance plant of the Anniston Ordnance Company and the possible installation of an electric steel furnace at Anniston by the Alabama Power Company.

Temple Furnace Goes to New Operators of Diamond State Steel Plant

The Delaware Steel & Ordnance Company, recently incorporated with $10,000,000 capital to operate the plant of the Diamond State Steel Company, Wilmington, Del., has acquired from H. H. Adams, of New York, and associates Temple furnace at Reading, Pa., which the latter bought in November from the Temple Iron Company. Albert Broden is manager of Temple furnace and a director in the new steel company of which Daniel J. Driscoll is president. Repairs and improvements to the Wilmington plant, which has five open-hearth furnaces, are in progress and operations will begin about March 1. Temple furnace was blown in late in November. The Delaware Steel & Ordnance Company is understood to have taken contracts for semi-finished steel and steel rounds.

The Ferguson Steel & Iron Company, Buffalo, N. Y., has opened a branch office at 204 Seitz Building, Syracuse, N. Y., with L. A. Remington, contracting engineer of the company, in charge. This enlargement has become necessary because of the continued increase of business in Syracuse territory. Additions are also being made to the central plant at Buffalo, where four more bays are now being erected, and three more will follow immediately.

PERSONAL

George E. Hodson, president and treasurer Winchester Repeating Arms Company, New Haven, Conn., has resigned because of impaired health. He had been with the company for forty-four years, entering its employ as a clerk and working his way up; holding the presidency since Feb. 18, 1911. The directors have elected Winchester Bennett president and treasurer, but appointed Thomas G. Bennett president and treasurer pro tem to serve during the disability of Winchester, who is convalescing from a serious illness.

On Christmas eve the employees of the American Machine Tool Works Company, Cincinnati, Ohio, presented Franklin Alter, president; J. B. Doan, vice-president and general manager, and A. E. Robinson, general superintendent, each, with a beautiful loving cup. The presentation speech was made by Charles Steffens, one of the company's lathe hands, who stated that the employees intended the gifts as a tangible token of their loyalty to the firm.

Campbell Scott, for the last eleven years manager of the Otis Elevator Company's plant at Yonkers, N. Y., resigned his position Dec. 31.

A. S. Baldwin has resigned as works manager of the R. D. Nuttall Company, Pittsburgh, having accepted the position of manager of ordnance for the Poole Engineering & Machine Company, Baltimore, Md. He had previously served three years as general manager of the Alberger Pump & Condenser Company, Newburg, N. Y., over four years as general superintendent of the Driggs-Seabury Ordnance Corporation, Sharon, Pa., and two years as superintendent of the American-British Mfg. Company, Bridgeport, Conn.

H. C. Belleville has been appointed assistant to the president of the Commonwealth Steel Company of St. Louis, Mo., and Granite City, Ill., relieving President Clarence H. Howard of much of the detail of his position. Mr. Belleville has been connected with the company ten years and for five years has been the private secretary of President Howard.

Although not officially confirmed, news from a reliable source in St. Louis, the headquarters of the company, is that James M. Buick will succeed E. F. Carry as first vice-president and general manager of the American Car & Foundry Company. Mr. Carry goes to the Haskell & Barker Car Company, Michigan City, Ind., as president. Mr. Buick began his career with the Michigan Car Company, Detroit, Mich., where he was born. He located in St. Louis in 1899 as general auditor of the American Car & Foundry Company, which had absorbed his company. In 1906 he was elected a vice-president.

H. A. Butz has been appointed chief engineer of the Donner Steel Company, Buffalo, N. Y. He was formerly chief engineer of the Dominion Iron & Steel Company, Sydney, N. S., recently with the H. Koppers Company, Pittsburgh, and was engineer in charge of construction of the plant of the New York State Steel Company for the Garrett-Cromwell Engineering Company.

Frank H. Johnson, formerly general manager of sales of the West Leechburg Steel Company, Pittsburgh, has resigned and has opened an office in Chicago, to handle iron and steel specialties.

Jacob B. Waddell, formerly general sales manager of the Brier Hill Steel Company, Youngstown, Ohio, has resigned, effective Jan. 1. It is stated that Mr. Waddell, with associates, intends to build a large sheet-mill plant in the Youngstown district. He is succeeded as general sales manager by P. H. Hubbard, formerly his assistant.

L. F. Nagle, who for the past eighteen years has been sales manager of the Worth Brothers Company, Coatesville, Pa., has resigned, effective Jan. 1. After the company was sold to the Midvale Steel & Ordnance Company, Mr. Nagle had charge of its entire plant until its reorganization was accomplished. Since then he had not only acted as sales manager but as head of the purchasing department.

Arthur H. Chamberlain has been appointed secretary-treasurer of the American Iron, Steel and Heavy Hardware Association, effective Jan. 1. He was for several years on the editorial staff of THE IRON AGE. For the last three years he has been connected with the hardware department of Wiebusch & Hilger, Ltd., New York. The office of the association is in the Marbridge Building, Broadway and Thirty-fourth Street, New York.

The Lehigh Valley Railroad announces the appointment of H. C. May as superintendent of motive power, succeeding F. N. Hibbitts, resigned. Mr. May's headquarters will be at South Bethlehem, Pa. He was graduated from Purdue University, Lafayette, Ind., and leaves the position of superintendent of motive power of the Monon to enter the service of the Lehigh Valley.

Stuart B. Marshall, who has been connected for 21 years with the Dunbar Furnace Company's operations at Dunbar, Pa., in various positions from chemist to assistant general manager, has resigned to become executive officer at Whitney (Badin), Stanly County, N. C., in charge of the property of the Aluminum Company of America. The new town of Badin, aluminum works and immense dams are under construction. Mr. Marshall assumes his new duties about Feb. 1.

R. G. Bullock has been appointed chief engineer of the Art Metal Construction Company, Jamestown, N. Y. He was formerly connected with the company, resigning to become a member of the firm of Metzger & Bullock, architects and engineers, New York City.

Clarence Hayward, office manager, Domhoff & Joyce Company, Cincinnati, Ohio, has returned from a vacation spent on the Pacific coast.

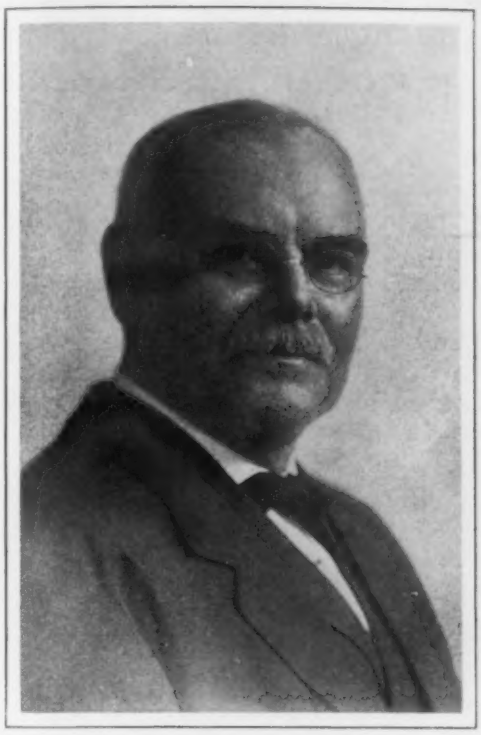
THOMAS M'DONALD RESIGNS

James H. Grose Succeeds Him as General Superintendent at Youngstown

Thomas McDonald, for nine years general superintendent of the Youngstown district of the Carnegie Steel Company, retired from that position on Jan. 1. He will continue with the company in an advisory capacity, with the title of consulting manager, being connected with the Youngstown district and the president's office in Pittsburgh. Mr. McDonald's connection with the Carnegie Steel Company began in 1875, when he was a carpenter at the Edgar Thomson works. In 1876 he became connected with the Bessemer department at that plant, and four years later was made turn foreman. In 1884 he was appointed night superintendent. He held this position until July, 1889, when he left the Carnegie Company to take charge of the Bessemer department of the Allegheny Bessemer Steel Company at Duquesne, Pa. In 1893 Mr. McDonald became general superintendent of the Ohio Steel Company at Youngstown and had charge of the construction of its plant. He was appointed to the position from which he has just retired on Jan. 1, 1907.

James H. Grose will succeed Mr. McDonald as general superintendent of the Youngstown district, being advanced from the position of superintendent of the Ohio works. He began his career with the Morse Bridge Company in Youngstown, and later was connected with the King Bridge Company in Cleveland. In 1887 he entered the employ of the Homestead Steel Company as head of the fabricating department. Mr. Grose later became connected with the Schoen Steel Wheel Company, McKees Rocks, Pa., and the Howard Axle Works, Homestead. He has been superintendent of the Ohio works of the Carnegie Steel Company for four years.

I. Lamont Hughes becomes assistant superintendent of the Youngstown district. He has been superintendent of the Upper and Lower Union mills of the Carnegie Company in Youngstown. Mr. Hughes first be-



THOMAS M'DONALD

JAMES H. GROSE

Mr. McDonald becomes consulting manager of the Carnegie Steel Company and Mr. Grose succeeds him as general superintendent of the Youngstown District of the company

came connected with this company when he graduated from the North Braddock high school in 1897. Starting in the engineering department of the Edgar Thomson works, he later went to Donora, Pa., and helped build the plant of the Union Steel Company, afterward a part of the American Steel & Wire Company. In 1905 he became engineer for the Youngstown district bar mills, comprising the Upper and Lower Union mills, Girard, Warren and Greenville mills and upon the retirement of M. E. Coombs in 1906 was made assistant under F. B. Baugh, general superintendent. Upon the death of Mr. Baugh in 1911 Mr. Hughes succeeded him as superintendent of the bar mills, which position he has filled to the present time.

OBITUARY

CARLES COOKE SCAIFE, president of the William B. Scaife & Sons Company, Pittsburgh, died Dec. 30 at his home in that city, aged 72 years. He was born in Pittsburgh and was educated in the local public schools. He was a veteran of the Civil War. For over fifty years he was identified with the business established in 1802 by his grandfather, Jeffrey Scaife. Since the death of his father, William B., in 1876, the active management of the business has been largely under his control. He was active in the Methodist Church. His last public service was the unveiling of the marker of the original town hall site in Allegheny on June 14, 1915. He was a member of the Duquesne and Allegheny Country clubs. He leaves his widow, two sons and one daughter.

WILLIAM W. SUPPLEE, Philadelphia, died Jan. 1, aged 83 years. He was formerly president of the Supplee Hardware Company and of the Trades League, now the Chamber of Commerce. He also was a member of the Union League and the City Club. He was born in Montgomery County, Pennsylvania. He leaves his widow and two daughters.

THOMAS WALLACE, for the last fifteen years managing director of the Waclark Wire Company, New York City, died Jan. 1, aged 89 years. He was born in Manchester, England, and was brought as a boy to this country by his parents. In 1839 his father established a wire mill at Annsville, N. Y., and in 1841 removed to Derby, Conn. In 1848, with his brothers and father, Mr. Wallace founded the firm of Wallace & Co., one of the first to make copper wire in this country. He was the first to introduce continuous wire machinery for drawing fine brass and copper wire, a process which revolutionized the industry. He leaves his widow and four sons.

G. FERDINAND EHRENZELLER, for several years a dealer in ferroalloys, ores and metals, with an office in the Pennsylvania Building, Philadelphia, died suddenly Jan. 1 at his home in that city, aged about 50 years. The week before Christmas he was in Pittsburgh on business and then appeared to be enjoying good health. He was well known in the Central West. He was a native of England, and leaves his widow and three children.

WILLIAM TURNER LEWIS, second vice-president Mitchell-Lewis Motor Company, Racine, Wis., and one of its founders, died suddenly from apoplexy in his home, Dec. 30, aged 75 years. He was born in Utica, N. Y., became a telegrapher and served through the Civil War as a military operator. In 1864 he married the daughtet of Henry Mitchell, the first wagon manufacturer in the Northwest.

H. A. COLWELL, president and general manager Kittanning Iron & Steel Company, died at Kittanning, Pa., Dec. 23, as the result of a stroke of apoplexy, aged 74 years.

Steel Corporation Stock for Employees

Announcement was made in the past week by Chairman E. H. Gary of the United States Steel Corporation that it would offer this month 35,000 shares of common stock for subscription by employees under the bonus and installment plan at 85. No offer of preferred stock is made. The customary stock offering to employees was omitted one year ago.

The Frye-Phipps Company, wholesale hardware merchant, 21-27 Pearl Street, Boston, Mass., celebrated its one hundredth anniversary Jan. 1. The company's business has successively been conducted under the style of Montgomery, Newell & Co., Coverly, Frye & Co., Frye, Phipps & Co. and the Frye-Phipps Company.

Iron and Steel Markets

VAST NEW STEEL CAPACITY

Will Pig-Iron Supply Be Equal to It?

Blast Furnaces Now Operating at the Rate of 38,800,000 Tons a Year

No year has held out such promise at its beginning as the American steel trade finds in looking forward into 1916. Never has so large a volume of firm orders, as distinguished from cancellable contracts, been on the books of the steel mills, and never since the Steel Corporation was formed have prices on future delivery business been at so high a level.

Heavy specifications came in in the final week of December and where these were not forthcoming the mills cut off remaining 1915 tonnage. Generally new orders in December were less than in November and the Steel Corporation's statement of next week is likely to show something less than the prodigious increase of November.

The annual canvass of new steel capacity under construction shows far greater additions under way for 1916 than any estimates the trade has entertained. Independent steel companies are building or have plans for 73 new open-hearth furnaces with an annual capacity of 2,715,000 tons of ingots, while the Steel Corporation has made appropriations for 18 new furnaces (including four large ones for duplexing), representing 1,550,000 tons a year.

Here is the amazing total of 4,265,000 tons of capacity coming forward—an amount fairly raising the question whether war prosperity may not lead to the overdoing of new construction. Perhaps half of it will be available in 1916 to relieve the present high pressure on the industry.

Adding open-hearth furnaces is only a matter of months, while to build a blast furnace means a year or more. To-day only 10 blast furnaces are under construction, representing 1,750,000 tons a year, and little of this capacity will be ready in 1916. This unbalanced situation, with its effect on pig-iron and scrap prices, as steel companies come into the market to feed their large melting capacity, is a factor of which more will be heard.

Pig-iron output in December made a further gain, in spite of expected holiday slackening, the output being 3,203,322 tons, or 103,333 tons a day, as compared with 3,037,308 tons in November, or 101,244 tons a day. Production on Jan. 1 was at 105,400 tons a day for 295 furnaces, as against 103,033 tons a day for 287 furnaces at the beginning of December.

The country is now making pig iron at the rate of 38,800,000 tons a year, including charcoal iron. At the opening of 1915, with 147 furnaces in blast, or half the number now running, the active capacity represented only about 18,000,000 tons. One of the results of the year is thus an increased output per unit in operation.

Bessemer pig iron has advanced at Pittsburgh, the entire available supply apparently being in the hands of two producers. A sale of 3500 tons for first-quarter delivery was made $21, Valley furnace, representing an advance of $1.50 a ton. A French buyer has offered $22 at furnace for 5000 tons or more of Bessemer iron for prompt shipment. A sale of 6000 tons of basic iron for first-half delivery has been made at $18, Valley furnace. A St. Louis steel company is in the market for 10,000 to 15,000 tons of basic which may be divided between Southern and Northern furnaces.

Southern foundry iron has sold at $15 to $15.50 for the first half and the tendency is upward. There are indications in other markets also of further advances in foundry iron. Buffalo furnaces are on higher ground.

The year opens with little headway in the relief of the export freight situation, though all iron and steel for which vessel connection is arranged is coming forward from the mills. South American shipments are not interrupted.

Inquiries for large rounds for England and France for the second half of the year have brought out prices ranging above 3.5c., at which there have been some demurrers.

Actual advances of the first week of the year include $2 a ton on black merchant pipe and line pipe and $1 to $2 a ton on oil country products.

Plates are still the feature of the market in their spectacular advance, 2.25c. and 2.50c. Pittsburgh being prompt prices. As the rise continues a question is raised here and there as to the cost of cars. The Chicago Great Western's inquiry for box cars has been withdrawn, this being the fourth road to take such action.

Eastern mills have advanced bar iron to a 2c., Pittsburgh, basis, a total of $6 in a month.

At Cleveland the buying of vessels by ore shippers has reached a scale only equaled when the Pittsburgh Steamship Company was formed 15 years ago. The Steel Corporation has taken up six large vessels in the past week and there has been vessel buying in the interest of the new steel combine.

Our estimate of the pig-iron production of last year is 29,950,000 gross tons, which puts the record of 1915, with all the handicap of six poor months at the beginning, second only to the 30,966,000 tons of 1913.

A Comparison of Prices

Advances Over the Previous Week in Heavy Type, Declines in Italics

At date, one week, one month, and one year previous

Pig Iron, Per Gross Ton:	Jan. 5, 1916.	Dec. 29, 1915.	Dec. 8, 1915.	Jan. 6, 1915.
No. 2 X, Philadelphia	**$19.75**	$19.50	$18.25	$14.25
No. 2, Valley furnace	18.50	18.50	17.50	13.00
No. 2 Southern, Cin'ti	**17.90**	17.40	16.90	12.40
No. 2, Birmingham, Ala.	**15.00**	14.50	14.00	9.50
No. 2, furnace, Chicago*	18.50	18.50	18.00	13.00
Basic, del'd, eastern Pa.	**19.50**	18.50	18.00	13.50
Basic, Valley furnace	18.00	18.00	17.50	12.50
Bessemer, Pittsburgh	**21.95**	20.45	19.45	14.70
Malleable Bess., Ch'go*	**19.00**	18.50	18.00	13.00
Gray forge, Pittsburgh	**18.45**	18.20	17.95	13.45
L. S. charcoal, Chicago	19.25	19.25	17.75	15.75
Billets, etc., Per Gross Ton:				
Bess. billets, Pittsburgh	$32.00	32.00	30.00	19.00
O.-h. billets, Pittsburgh	33.00	33.00	31.00	19.00
O.-h. sheet bars, P'gh	35.00	35.00	31.00	20.00
Forging billets, base, P'gh	55.00	55.00	52.00	24.00
O.-h. billets, Phila	40.00	40.00	36.00	21.40
Wire rods, Pittsburgh	40.00	40.00	40.00	25.00
Finished Iron and Steel, Per Lb. to Large Buyers:	Cents.	Cents.	Cents.	Cents.
Bess. rails, heavy, at mill	1.25	1.25	1.25	1.25
Iron bars, Philadelphia	**2.159**	2.059	1.959	1.17½
Iron bars, Pittsburgh	**1.95**	1.80	1.80	1.15
Iron bars, Chicago	1.75	1.75	1.60	0.97½
Steel bars, Pittsburgh	2.00	2.00	1.70	1.10
Steel bars, New York	2.169	2.169	1.869	1.26
Tank plates, Pittsburgh	2.25	2.25	1.90	1.10
Tank plates, New York	2.419	2.419	2.169	1.26
Beams, etc., Pittsburgh	1.90	1.90	1.70	1.10
Beams, etc., New York	2.069	2.069	1.869	1.26
Skelp, grooved steel, P'gh	**1.80**	1.70	1.70	1.10
Skelp, sheared steel, P'gh	**1.90**	1.80	1.80	1.15
Steel hoops, Pittsburgh	2.00	2.00	1.90	1.20

*The average switching charge for delivery to foundries in the Chicago district is 50c. per ton.

Sheets, Nails and Wire, Per Lb. to Large Buyers:	Jan. 5, 1916. Cents.	Dec. 29, 1915. Cents.	Dec. 8, 1915. Cents.	Jan. 6, 1915. Cents.
Sheets, black, No. 28, P'gh	**2.60**	2.50	2.50	1.80
Galv. sheets, No. 28, P'gh	4.75	4.75	4.75	2.75
Wire nails, Pittsburgh	2.10	2.10	2.00	1.50
Cut nails, Pittsburgh	**2.00**	1.90	1.90	1.50
Fence wire, base, P'gh	1.95	1.95	1.85	1.30
Barb wire, galv., P'gh	2.95	2.95	2.85	1.90
Old Material, Per Gross Ton:				
Iron rails, Chicago	**17.50**	16.00	16.00	11.25
Iron rails, Philadelphia	19.50	19.50	19.00	13.00
Carwheels, Chicago	14.75	14.75	14.50	9.75
Carwheels, Philadelphia	16.00	16.00	15.00	11.00
Heavy steel scrap, P'gh	17.50	17.50	17.50	11.50
Heavy steel scrap, Phila	16.00	16.00	15.50	10.00
Heavy steel scrap, Ch'go	**16.00**	**16.00**	**15.00**	**9.00**
No. 1 cast, Pittsburgh	15.25	15.25	15.25	11.25
No. 1 cast, Philadelphia	**17.00**	16.75	15.00	12.00
No. 1 cast, Ch'go (net ton)	13.75	13.75	13.75	9.25
Coke, Connellsville, Per Net Ton at Oven:				
Furnace coke, prompt	**$3.25**	$3.00	$2.10	$1.50
Furnace coke, future	**2.50**	2.40	2.40	1.75
Foundry coke, prompt	**3.50**	3.25	2.75	**2.00**
Foundry coke, future	**3.25**	3.00	3.00	**2.15**
Metals, Per Lb. to Large Buyers:	Cents.	Cents.	Cents.	Cents.
Lake copper, New York	**22.87½**	22.25	19.87½	13.50
Electrolytic copper, N. Y.	**22.87½**	22.25	19.62½	13.00
Spelter, St. Louis	17.25	17.25	14.75	5.60
Spelter, New York	17.50	17.50	15.00	5.75
Lead, St. Louis	**5.40**	5.32½	5.17½	3.60
Lead, New York	**5.50**	5.40	5.25	3.80
Tin, New York	**45.00**	39.25	37.25	33.25
Antimony, Asiatic, N. Y.	**41.00**	39.50	39.00	13.00
Tin plate, 100-lb. box, P'gh	**$3.75**	$3.60	$3.50	$3.10

Pittsburgh

PITTSBURGH, PA., Jan. 4, 1916.

The year 1916 has opened most auspiciously. Prices of steel products are at the highest level reached in some years, mills have their product sold for three months or longer and the outlook for a continuance of the unprecedented activity is most excellent. The past week Bessemer pig iron advanced squarely $1.50 per ton and the leading interest advanced its price on coke tin plate 15c. per box. The whole market, as regards prices, is very strong. While the embargo on export shipments of iron and steel is still in force, the railroads are making every effort to move the congested freight and promise that the situation will be relieved inside of two weeks. In the meantime domestic consumers are profiting by getting quicker deliveries on their contracts than they have had for months.

Pig Iron.—A spectacular advance was made of about $1.50 a ton in the price of Bessemer iron in the past week, an interest at Cleveland, Ohio, having sold to the Carbon Steel Company of this city 3500 tons for first quarter delivery on the basis of $21, Valley furnace. The iron was sold at $21.95, delivered, but the seller has a freight rate of 76c., against 95c. from the Valley, so that the iron nets the seller $21.19 at furnace. The same buyer also previously purchased 500 tons of Bessemer iron from the same seller on the basis of $20, Valley furnace. A French representative, who is trying to buy 5000 tons or more of Bessemer for prompt shipment, has offered $22 and higher, Valley furnace. It is said that the entire available supply of Bessemer is now held by a local dealer and a Cleveland interest, which accounts for the high prices now being realized. The Standard Steel Works Company, Burnham, Pa., has bought 6000 tons of basic for first half delivery at $18, Valley furnace. Foundry is quiet, consumers being pretty well covered through first quarter. W. P. Snyder & Co. report the average price of Bessemer in December, based on actual sales of 1000 tons or more, to have been $19.021 and of basic, $17.487, both at Valley furnace. In Bessemer this is an advance of $3.406 over the November price, and in basic $1.0929. We now quote standard Bessemer iron at $21; basic, $18; malleable Bessemer, $17.50; No. 2 foundry, $18.50 to $19, and gray forge, $17.50, all at Valley furnace, the freight rate for delivery in the Pittsburgh and Cleveland districts being 95c. per ton.

Billets and Sheet Bars.—It is said that large consumers of sheet bars who have contracts will pay $33 or higher for the first quarter. Indications point to a shortage in the supply of steel for the first six months of the year and perhaps the entire year. We quote Bessemer billets and sheet bars at $32 to $33 and open-hearth billets and sheet bars at $33 to $35, maker's mill, Pittsburgh or Youngstown district. We quote forging billets at $55 to $56, for sizes up to but not including 10 x 10 in. and for carbons up to 0.25, the regular extras being charged for larger sizes and higher carbons. Forging billets running above 0.25 and up to 0.60 carbon take $1 per ton extra.

Ferroalloys.—English 80 per cent ferromanganese is very strong at $110 to $115, seaboard, with no guarantee as to deliveries, and domestic 80 per cent ferromanganese is $125 to $130 at maker's furnace. We note sales of two cars, or about sixty tons of domestic at $125, seaboard. Prices of Bessemer ferrosilicon for delivery in second quarter are as follows: 9 per cent, $27; 10 per cent, $28; 11 per cent, $29; 12 per cent, $30; 13 per cent, $31.50; 14 per cent, $33.50; 15 per cent, $35.50, and 16 per cent, $38. Seven per cent silvery for same delivery is $24.50; 8 per cent, $25; 9 per cent, $25.50; 10 per cent, $26; 11 per cent, $27, and 12 per cent, $28. All these prices are f.o.b. at furnace, Jackson, Ohio; New Straitsville, Ohio, or Ashland, Ky., each of these points having a freight rate of $2 per gross ton to Pittsburgh. We quote 50 per cent ferrosilicon for delivery through all of 1916 as follows: Up to 100 tons, $85; over 100 tons and up to 600 tons, $84, and over 600 tons, $83; all per gross ton, delivered in the Pittsburgh district.

Plates.—The Standard Steel Car Company is reported to have taken a contract for 5000 steel freight cars for France, and the Westinghouse Air Brake Company is to supply the air brakes. The Pennsylvania Railroad is still in the market for 9000 or more cars, the Union Pacific for 2000 and the Denver & Rio Grande for 1000. The two local car companies are well filled for three months. Prices on plates are very strong, one leading steel company stating it could readily sell ¼-in. and heavier plates for second quarter at 2.25c. or higher at mill. We quote ¼-in. and heavier plates at 1.80c.

for shipment at convenience of the mill, and for delivery in three or four weeks, 2.25c. to 2.40c., at maker's mill.

Structural Material.—New inquiry is active. The Cleveland & Youngstown Railroad has placed 4000 tons of bridge work with the King Bridge Company, Cleveland, Ohio, the material to be rolled by a Pittsburgh mill. The Fort Pitt Bridge Works has taken 1500 tons or more for extensions to the buildings of the Wheeling Steel & Iron Company at Yorkville, Ohio; the Penn Bridge Company, Beaver Falls, Pa., 650 tons for new buildings for the Phillips Sheet & Tin Plate Company, Weirton, W. Va., and the McClintic-Marshall Company, 275 tons for an ore bridge for the Union Furnace Company, Buffalo, N. Y. The Erie Railroad is in the market for 1400 tons of bridge work. We quote beams and channels up to 15 in. at 1.80c. to 1.90c. at mill, Pittsburgh, prices depending on delivery wanted.

Steel Rails.—Some moderate orders are being placed for light rails and standard sections. We quote standard section rails of Bessemer stock at 1.25c., and of open-hearth steel, 1.34c., f.o.b. Pittsburgh. We quote light rails as follows: 25 to 45-lb. sections, 1.55c.; 16 and 20 lb., 1.60c.; 12 and 14 lb., 1.65c.; 8 and 10 lb., 1.70c., in carloads, the usual advances being charged for less than carloads.

Sheets.—The demand for blue annealed, black and galvanized sheets is fairly heavy. Nearly all the sheet mills are operating close to 100 per cent and prices are very strong. For delivery through first quarter we quote Nos. 9 and 10 blue annealed sheets at 2.25c.; No. 28 Bessemer black, 2.60c., and No. 28 galvanized, 4.75c. We quote Nos. 22 and 24 black plate, tin mill sizes, H. R. and A., at 2.30c. to 2.40c.; Nos. 25, 26 and 27, 2.35c.; No. 28, 2.40c.; No. 29, 2.45c., and No. 30, 2.50c. These prices are for carload and larger lots, f.o.b. maker's mill.

Tin Plate.—Effective Monday, Jan. 3, the American Sheet & Tin Plate Company advanced its price on coke plates from $3.60 to $3.75 per base box, following similar action by the outside tin-plate mills early last week. It is reported that this interest has taken one contract for 115,000 boxes at the new price. Most of the heavy buying for 1916 delivery was done some time ago at $3.50 and $3.60. The mills are filled with orders for the next two or three months and are running close to 100 per cent of capacity. We quote 14 x 20 coke plates at $3.75 per base box, and 200-lb. base, common ternes, 8-lb. coating, at $6.90 per box.

Railroad Spikes.—No large orders have lately been placed and specifications from railroads are quiet. We quote standard spikes, larger than ½ in., at $2.10; from ½ in. to ⅜ in., $2.20, and 5/16-in. and ⅜-in. diameter, $2.35, all per 100 lb., base, f.o.b. at mill.

Skelp.—Mills are filled for two or three months ahead and prices are higher. We now quote grooved steel skelp at 1.80c. to 1.85c.; sheared steel skelp, 1.90c. to 1.95c.; grooved iron skelp, 2.20c. to 2.25c., and sheared iron skelp, 2.30c. to 2.35c., all delivered to consumers' mills in the Pittsburgh district.

Wire Rods.—Local mills are sold up for four to six months, have no rods to spare for the open market, and cannot quote on export inquiries. We quote Bessemer, open-hearth and chain rods at $40 to $42 for delivery at convenience of the mill.

Wire Products.—It is stated that shipments in December by the American Steel & Wire Company were over 200,000 tons of wire products, the heaviest business in any one month in its history. The demand for wire and wire nails continues abnormally heavy. Local makers and the Youngstown producer are practically out of the market, having their output sold for the next three or four months. Premiums of $3 to $5 per ton or more on barb wire are offered for delivery within three or four months, and it is said premiums of 10c. to 15c. per keg or more are offered for wire nails for prompt shipment. Prices quoted to the large trade and for shipment at convenience of the mill, are as follows: Wire nails, $2.10; galvanized nails 1 in. and longer taking an advance over this price of $2, and shorter than 1 in., $2.50; plain annealed wire, $1.95; galvanized barb wire and fence staples, $2.95; painted barb wire, $2.25; polished fence staples, $2.25, all f.o.b., Pittsburgh, with freight added to point of delivery; terms sixty days net, less 2 per cent off for cash in ten days. Prices on woven wire fencing are 67½ per cent off list for carload lots, 66½ per cent for 1000-rod lots, and 65½ per cent for small lots, f.o.b., Pittsburgh.

Hoops and Bands.—New demand is active and mills report specifications against contracts as very heavy. We quote steel bands at 1.80c., with extras as per the steel bar card, and steel hoops 2c., f.o.b., Pittsburgh, both for delivery at convenience of the mill.

Cold-Rolled Strip Steel.—Prices quoted by local makers are largely nominal, as they are sold up for four or five months and cannot take offered business for prompt delivery. We quote cold-rolled steel, 1½ in. and wider, under 0.20 carbon, sheared or natural mill edge, per 100 lb., $3.50 to $3.75 delivered at convenience of the mill. Prices as high as $4 base or more have been offered for prompt shipment.

Shafting.—It is not now a question of price, but where to find a maker that can promise delivery within three or four weeks. Local makers are quoting 45 per cent off in carloads and 40 per cent off in less than carloads for shipment at their convenience, which likely would be four to six months from date of order.

Iron and Steel Bars.—The market on both iron and steel bars is very active. While the nominal price of steel bars for shipment at convenience of the mill is 1.80c., deliveries in three or four weeks bring 2c. and higher, and from warehouse 2.35c. to 2.50c. Local steel-bar mills are practically filled for six months. The new demand for iron bars is heavy and prices are higher. We quote refined iron bars at 1.95c. to 2c., and railroad test bars, 2.05c. to 2.10c., f.o.b. maker's mill.

Rivets.—Better deliveries are now being made to domestic consumers on account of the railroad embargo on export shipments. Makers are sold up for three to four months and are much behind in deliveries. We quote button-head structural rivets, ½ in. and larger, at $2.50, and cone-head boiler rivets at $2.60 per 100 lb., in carload lots, f.o.b. Pittsburgh, smaller lots bringing about 10c. advance.

Nuts and Bolts.—Prices are very strong. Local makers are back in deliveries 8 to 10 weeks and report they are sold up for three months or longer.

Merchant Steel.—Output and shipments by the mills in December were probably the heaviest of any one month for over two years. For small lots for delivery at convenience of the mill we quote: Iron finished tire, ½ x 1½ in. and larger, 2.05c., base; under ½ x 1½ in., 2.20c.; planished tire, 2.25c.; channel tire, ¾ to ⅞ and 1 in., 2.55c. to 2.65c.; 1 x ⅛ in., and larger, 2.95c.; toe calk, 2.65c. to 2.75c., base; flat sleigh shoe, 2.40c.; concave and convex, 2.45c.; cutter shoe, tapered or bent, 2.95c. to 3.05c.; spring steel, 2.65c. to 2.75c.; machinery steel, smooth finish, 2.45c.

Carwheels.—Local makers are sold up for four to six months, and car companies say deliveries they are getting on steel wheels are very unsatisfactory. We quote 33-in. freight carwheels in lots of 1000 or more at $18; 33-in. tender wheels, $21; 36-in. passenger or tender wheels, $25. These prices are based on a 10-in. diameter hub, 50c. extra being charged for 11-in., all f.o.b. Pittsburgh.

Wrought Pipe.—The demand for wrought-iron and steel pipe is very active and the outlook for 1916 is excellent. Oil country goods are also in heavy demand. The Philadelphia Company of this city is in the market for its needs of this year of iron pipe casing and oil well supplies, amounting to about 10,000 tons and this business is expected to be placed shortly. Effective Tuesday, Jan. 4, discounts on black and galvanized and reamed and drifted steel pipe were lowered one point, equal to an advance of $2 per ton. It is likely the same advance will be made in iron pipe this week. Oil country goods have been advanced $1 to $2 per ton, depending on size and classification; line pipe, one point, or $2 per ton, and standard merchant casing, about $2 per ton.

Boiler Tubes.—New demand for both locomotive and merchant tubes is very heavy, and on the former the two local makers say they are sold up for three or four months. Some users of seamless tubes are now taking boiler tubes, being unable to get deliveries of seamless. Discounts are very firm.

Old Material.—Two consumers in the Youngstown district are buying heavily, and it is said that a leading local consumer will take all the steel scrap in the recent list of the Pennsylvania Railroad. Now that the holidays are over, dealers expect other consumers of scrap to enter the market. There are no embargoes at present, and the consumption of scrap is enormously heavy. Dealers quote for delivery in the Pittsburgh and nearby districts that take the same rates of freight, as follows, per gross ton:

Heavy steel melting scrap, Steubenville, Follansbee, Brackenridge, Sharon, Monessen, Midland and Pittsburgh delivery	$17.50
Compressed side and end sheet scrap	16.00
No. 1 foundry cast	$15.25 to 15.50
Bundled sheet scrap, f.o.b. consumers' mills, Pittsburgh district	14.00 to 14.25
Rerolling rails, Newark and Cambridge, Ohio, Cumberland, Md., and Franklin, Pa.	18.50 to 18.75
No. 1 railroad malleable stock	15.50
Railroad grate bars	10.75 to 11.00
Low phosphorus melting stock	21.50
Iron car axles	24.50 to 25.00
Steel car axles	26.00 to 26.50
Locomotive axles, steel	24.00 to 24.50
No. 1 busheling scrap	15.00
Machine shop turnings	10.00 to 10.25
Old carwheels	14.50
Cast-iron borings	10.75 to 11.00
*Sheet bar crop ends	18.00 to 18.50
Old iron rails	16.00 to 16.50
No. 1 railroad wrought scrap	17.50
Heavy steel axle turnings	13.50 to 14.00
Heavy breakable cast scrap	13.50 to 14.00

*Shipping point.

Coke.—Producers of coke who made sliding scale contracts late last year for delivery in first half or over all of 1916 are feeling very well satisfied. One contract for 12,000 tons for blast-furnace coke per month for first half of this year was made on a minimum of $13.50, Valley furnace, for basic iron, the producer to receive for his coke one-fifth of the total advance in the price of basic iron. As the latter is now selling at $18, Valley furnace, or an advance of $4.50 per ton over the price named in the coke contract, the producer will receive one-fifth of this, or 90c. per ton advance over the base price for the coke in the contract, which was $1.80, the January coke netting the seller $2.70 per net ton at oven. New demand for blast-furnace coke for prompt shipment is quiet, but prices are firm. We quote best grades of blast furnace coke for spot shipment at $3.25 to $3.50 and on contracts for first half about $2.50 per net ton at oven. Best grades of 72-hr. foundry coke for prompt shipment are selling at $3.50 to $3.75, and on contracts from $3.25 to $3.50 per net ton at oven. The Connellsville *Courier* reports the output of coke in the upper and lower Connellsville regions for the week ended Dec. 25 as about 419,000 tons, a decrease over the previous week of about 27,000 tons, due to holidays.

Buffalo

BUFFALO, N. Y., Jan. 3, 1916.

Pig Iron.—Although this is usually the dullest period of the year, furnacemen report a remarkably large aggregate of small-lot orders as well as insistent demand for iron under contract. One interest is shipping at the rate of 10,000 tons per month from re-sale iron, besides its current full capacity production. Prices for delivery over last half range from $18.50 to $19 at furnace. For delivery over the first half of the year we quote, f.o.b. furnace, Buffalo, as follows, the lower prices applying solely to re-sale iron:

No. 1 foundry	$18.25 to $20.00
No. 2 X foundry	18.00 to 20.00
No. 2 plain	18.00 to 20.00
No. 3 foundry	17.50 to 20.00
Gray forge	17.50 to 20.00
Malleable	19.00 to 20.00
Basic	20.00
Charcoal, regular brands and analysis	21.00 to 22.00

Finished Iron and Steel.—While the nominal price of bars, shapes and plates still remains at 1.80c., Pittsburgh, sellers could readily obtain 2c. if they had the steel, and in some instances as high as 2.25c. to 2.50c. In the face of this situation warehouse stocks are becoming depleted in a number of sizes. There has been an advance on spikes. Standard railroad spikes, 4½ x 9/16 in. and larger, are now $2.25 per 100 lb.; ½ and 7/16 in. and boat spikes, $2.35 per 100 lb.; 5/16 in. and ⅜ in., $2.50 per 100 lb. Proof coil chain has been advanced to $3.75, base, per 100 lb. for ⅜-in., other sizes in proportion.

Old Material.—The scrap market has been quiet but the price situation continues strong. No. 1 wrought scrap, which is scarce, advanced 50c. per ton. Low phosphorus steel scrap, old iron rails, locomotive grate bars, and stove plate (net ton) all advanced 50c. per ton each, and No. 1 busheling scrap advanced $1 per ton. There has been a temporary lull in the demand for heavy melting steel, the principal consumer standing pat for the time being on stock previously secured. The embargo placed by the Canadian Government on steel and wrought scrap last week, for exportation into the United States is still in force. Its effect has been felt at the principal producing points in Canada by a sharp drop in prices, which will no doubt go to a lower level if the embargo remains effective. We quote dealers' asking prices, f.o.b. Buffalo, per gross ton, as follows:

Heavy melting steel	$16.50 to $17.00
Low phosphorus steel	21.00 to 21.50
No. 1 railroad wrought	17.00 to 17.50
No. 1 railroad and machinery cast	15.25 to 15.75
Old steel axles	22.00 to 22.50
Old iron axles	22.00 to 22.50
Old carwheels	15.25 to 15.75
Railroad malleable	15.25 to 15.75
Machine shop turnings	7.75 to 8.25
Heavy axle turnings	12.00 to 12.50
Clean cast borings	9.25 to 9.75
Iron rails	17.50 to 18.00
Locomotive grate bars	11.50 to 12.00
Stove plate (net ton)	10.00 to 10.50
Wrought pipe	13.00 to 13.50
Bundled sheet scrap	12.00 to 12.50
No. 1 busheling scrap	14.50 to 15.00
No. 2 busheling scrap	11.00 to 11.50
Bundled tin scrap	15.00 to 15.50

Philadelphia

PHILADELPHIA, PA., Jan. 4, 1916.

The usual holiday lull was minimized as never before. The iron and steel trade regards the outlook optimistically, as might be expected when it is well sold up for the first half, with inquiry for the second half swelling in volume. J. P. Morgan & Co. are sounding the mills as to what deliveries of steel rounds they can make in the second half. The quotations for rounds range from 3.50c. to 4c. Morgan & Co., as Great Britain's purchasing and fiscal agents, have signified the price they are willing to pay, and the trade admits that unquestioned credit is worth something. Inquiry for other products for far off delivery is growing also. The freight situation is a little easier, but still uncertain. In steel products, plates lead in activity. Billets are not quoted for first quarter delivery. Many of the mills in eastern Pennsylvania are suffering from the epidemic of grip which is sweeping this region. When a superintendent or other manager is incapacitated, as often happens, it is nowadays a serious matter.

Pig Iron.—As was to be expected, the past few days have been quiet, but there has been nothing like the lull usual at this season. Many buyers were away from business, inventories were going on, and the wide prevalence of sickness added its effect. Current inquiry is mainly for small lots, yet the outlook is excellent. Quotations are irregular, but a trifle stronger in some instances. One brand of eastern Pennsylvania No. 2 X continues at $20, furnace, taking a freight rate of 79c., but lower can be done on prompt shipment. A round lot of eastern Pennsylvania No. 2 plain was purchased at $19.50, delivered. A brand of Virginia No. 2 X is quoted at $17.25, furnace, first quarter and first half; while for another make, $18.50, furnace, is asked for first half, both taking a freight rate of $2.75. A fair-sized lot of Virginia No. 2 X,

first half delivery, was taken at $19, furnace, or $21.75, Philadelphia, and a lot of Virginia No. 2 plain, January shipment, went at $18, furnace, or $20.75, Philadelphia. Purchases of 2000 or 3000 tons of standard low phosphorus are reported at near $32, delivered. Lebanon low phosphorus is quoted at $30, furnace, and upward. There has been no activity in basic, none of which can be had under $19.50, delivered. Quotations for standard brands, delivered in buyers' yards, prompt shipment, range about as follows:

Eastern Pa., No. 2 X foundry	$19.75 to $20.25
Eastern Pa., No. 2 plain	19.50 to 20.00
Virginia, No. 2 X foundry	19.75 to 20.25
Virginia No. 2 plain	19.25 to 19.75
Gray forge	18.25 to 19.75
Basic	19.50
Standard low phosphorus	32.00

Iron Ore.—Arrivals in the week ended Jan. 1 were 5000 tons from Cuba, 3146 tons from Spain, 6446 tons from Sweden, and 6000 tons from Chile.

Ferroalloys.—English ferromanganese is strong at the new quotation, $110, seaboard. The domestic product, 80 per cent, is quoted up to $125. To date, three cargoes of Indian manganese ore have been delivered to an eastern Pennsylvania steel mill, and a fourth contract has just been closed for the early shipment of over 6000 tons from Bombay.

Bars.—Leading makers of steel bars continue out of the market, and the nominal quotation of 1.80c., Pittsburgh, or 1.959c., Philadelphia, is unchanged. Two of the principal sellers find inquiry much lighter, a condition which they ascribe to the fact that they have discouraged business by withdrawing from the market, as well as to the holidays. Specialties are all that are offered by either mill. Iron bars are higher at 2.159c., Philadelphia, for carloads and 2.341c. for less than carloads.

Plates.—The pressure on a prominent mill in this district is so great that it is quoting 2.50c., Pittsburgh, or 2.659c., Philadelphia, to regular customers, and not quoting to others. None of its orders is for export. Another mill, which does not specialize in plates, as does the one first referred to, quotes 2.35c., Pittsburgh, or 2.50c., Philadelphia. It is being urged to hurry shipments, and its specifications against contracts are fast accumulating. The abnormal condition existing in plates is attributed to the scarcity created by the heavy demands of the shipyards.

Structural Material.—Quotations are unchanged at 2c., Pittsburgh, or 2.159c., Philadelphia, which is the minimum, and 2.25c., Eastern mill or Pittsburgh, according to the location of the buyer. Locally it has been quiet in the past week, and new propositions worthy of mention appear to be absent. An unusual phase of the situation is the extent to which consumers over-specified their last quarter contracts. All took out the last pound under contracts expiring Jan. 1, and will make the material carry them as far as possible before specifying against the more costly first quarter contracts.

Billets.—Local producers are about as nearly sold up as they can be, but when they are asked for prices on forging billets they quote $55 to $60. Open-hearth rerolling billets, second quarter delivery, are quoted at $40 to $45.

Sheets.—Under a heavy demand the quotation for No. 10 blue annealed sheets has gone to 2.60c., Pittsburgh, or 2.759c., Philadelphia.

Coke.—After shopping around, consumers have placed orders for a few carloads of prompt delivery foundry coke at $4 at oven. Spot furnace coke continues fairly active at $3.25 to $3.50 per net ton at oven, and contract through the first half at $2.35 to $2.50. Prompt foundry ranges from $3.50 to $4, and contract at $3 to $3.50. Freight rates from the principal producing districts follow: Connellsville, $2.05; Latrobe, $1.85, and Mountain, $1.65.

Old Material.—For some choice heavy melting steel one mill is reported to have paid $16.75. The market has been quiet, but is strong and the trade is in a most optimistic mood. Quotations for delivery in buyers' yards in this district, covering eastern Pennsylvania and taking freight rates from 35c. to $1.35 per gross ton, are as follows:

No. 1 heavy melting steel	$16.00 to $16.50
Old steel rails, rerolling	18.00 to 19.00
Low phos. heavy melting steel scrap	21.50 to 22.50
Old steel axles	25.00 to 26.00
Old iron axles	27.00 to 28.00
Old iron rails	19.50 to 20.00
Old carwheels	16.00 to 16.50
No. 1 railroad wrought	22.00 to 23.00
Wrought-iron pipe	16.00 to 16.50
No. 1 forge fire	13.00 to 13.50
Bundled sheets	13.00 to 13.50
No. 2 busheling	10.50 to 11.00
Machine shop turnings	11.50 to 12.00
Cast borings	11.50 to 12.00
No. 1 cast	17.00 to 18.00
Grate bars, railroad	12.50 to 13.00
Stove plate	13.00 to 13.50
Railroad malleable	15.00 to 15.50

Cincinnati

CINCINNATI, OHIO, Jan. 4, 1916.—(*By Wire.*)

Pig Iron.—Only a few inquiries came out last week, most of which were for last half shipment as the majority of consumers in this territory are fairly well covered up to July 1. Some sales of Southern warrant iron were made, included in which is one to a nearby melter for approximately 1200 tons at a price slightly below this week's quotations. A central Ohio manufacturer purchased 2000 tons of Southern foundry for first half shipment and another melter in the same territory took 1800 tons for last half. Southern No. 2 appears to be fairly well established at $15 to $15.50 for either prompt or first half movement, although one producer is asking as high as $16.50, Birmingham basis. A few contracts have been made at the minimum prices given for shipment in the last half. Northern foundry is firm at $18, Ironton, for prompt shipment, but contracts extending through the third quarter are said to be acceptable at the same figure. Basic and malleable are scarce and not obtainable for prompt shipment. The Ohio silvery irons are a little more active but $25 at furnace can still be done. Before the end of the month all Northern and Southern furnace books will doubtless be formally opened for last half delivery which should stimulate business. Virginia foundry irons continue to figure as a factor in part of this territory, but only small sales have been made lately. Based on freight rates of $2.90 from Birmingham and $1.26 from Ironton, we quote, f.o.b., Cincinnati, as follows:

Southern coke, No. 1 f'dry and 1 soft.	$18.40 to $18.90
Southern coke, No. 2 f'dry and 2 soft.	17.90 to 18.40
Southern coke, No. 3 foundry	17.40 to 17.90
Southern No. 4 foundry	16.90 to 17.40
Southern gray forge	16.40 to 16.90
Ohio silvery, 8 per cent silicon	26.26 to 26.76
Southern Ohio coke, No. 1	20.76 to 21.26
Southern Ohio coke, No. 2	19.76 to 20.26
Southern Ohio coke, No. 3	19.26 to 19.76
Southern Ohio malleable Bessemer	19.26 to 19.76
Basic, Northern	19.26 to 19.76
Lake Superior charcoal	20.70 to 21.70
Standard Southern carwheel	24.40 to 24.90

(*By Mail*)

Coke.—The holidays somewhat disrupted the labor situation in all districts, and spot furnace and foundry cokes are both higher. Quotations on furnace coke range from $3.25 to $3.60 per net ton at oven and foundry from 25c. to 50c. more. Contract figures on furnace coke are around $2.25 to $2.50 at oven and on foundry coke from $3 to $3.75. Not much business is being transacted.

Finished Material.—The demand for many kinds of iron and steel products has not slackened nearly as much as usual at this time of the year. The local warehouses are still receiving quite a number of rush orders for reinforcing concrete bars, small structural shapes and galvanized sheets. The store price on No. 28 galvanized sheets is still below mill quotations, being around 5c., but the tonnage in stock is getting low. The mill quotations on No. 28 galvanized sheets is 5.15c., Cincinnati, or Newport, Ky., and 2.65c. for No. 28 black sheets. Wire nails from jobbers' stocks are firmer at $2.15 per keg base.

Old Material.—Prices continue firm, but only a limited amount of business is being transacted. So far

no reports as to delays in shipments have come to light. The minimum figures given below represent what dealers are willing to pay for delivery in their yards, southern Ohio and Cincinnati, and the maximum quotations are dealers' prices f.o.b. at yards:

Per Gross Ton

Bundled sheet scrap	$11.00 to $11.50
Old iron rails	15.75 to 16.25
Relaying rails, 50 lb. and up	21.25 to 21.75
Rerolling steel rails	15.00 to 15.50
Heavy melting steel scrap	14.50 to 15.00
Steel rails for melting	14.25 to 15.25

Per Net Ton

No. 1 railroad wrought	$13.75 to $14.25
Cast borings	7.75 to 8.25
Steel turnings	7.50 to 8.00
Railroad cast scrap	12.00 to 12.25
No. 1 machinery cast scrap	13.75 to 14.25
Burnt scrap	9.00 to 9.50
Iron axles	19.50 to 20.00
Locomotive tires (smooth inside)	13.50 to 14.00
Pipes and flues	10.50 to 11.00
Malleable and steel scrap	11.00 to 11.50
Railroad tank and sheet scrap	9.00 to 9.50

Cleveland

CLEVELAND, OHIO, Jan. 3, 1916.

Iron Ore.—The market quieted down during the holidays, but a moderate volume of business is expected in the next few weeks as some consumers, particularly merchant furnaces, have not yet covered for their requirements. Reports from the Mesaba district indicate a possibility that the miners will ask for an increase in wages. We quote prices as follows, delivered lower Lake ports: Old range Bessemer, $4.45; Mesaba Bessemer, $4.20; old range non-Bessemer, $3.70; Mesaba non-Bessemer, $3.55.

Pig Iron.—The market is firm but dull. The most important transaction is the reported sale by a Cleveland interest of a round lot of Bessemer iron for delivery in the Pittsburgh district. Some sellers now show more of a disposition to take on tonnage for the last half and inquiries for that delivery would bring out prices, but possibly slightly higher than those prevailing for the first half. The only important inquiry pending is from the General Electric Company, for 1400 tons of foundry iron for its Erie plant, for the second quarter and for the same amount of iron for the third quarter. We quote, delivered Cleveland, as follows:

Bessemer	$20.95 to $21.95
Basic	19.30
Northern No. 2 foundry	19.30
Southern No. 2 foundry	18.50 to 19.00
Gray forge	18.30
Jackson Co. silvery 8 per cent silicon	26.62
Standard low phos., Valley furnace	31.00

Coke.—Some producers, including makers of by-product coke, are behind on shipments, and some foundries did not contract for as much as they needed. As a result there is a fair demand for foundry coke for prompt shipment, which is very firm, and sales are being made at higher prices. We quote standard makes of Connellsville foundry coke at $3.75 to $4.25 per net ton at oven for prompt shipment. Quotations for contracts range from $3.25 to $3.75.

Finished Iron and Steel.—Considerable new inquiry has come from railroads for structural material for bridge work, but there is a probability that because of the high price of steel some work that can be put off will be deferred until another year. The Clover Leaf has an inquiry out for about 2000 tons, the Lake Shore for several thousand tons, and inquiries from other roads aggregate about 1000 tons. The Clover Leaf has placed an order for 10,000 tons of rails with the Carnegie and Illinois steel companies. Specifications in the last day or two of the old year were very heavy and practically no tonnage was left on the books to be cancelled. Many consumers have already specified for all the steel they have under contract for the first quarter and are trying to place additional tonnage. Considerable structural work is in prospect, including several thousand tons for a terminal freight depot for the Cleveland & Youngstown Railroad. The demand for plates continues heavy and local quotations range from 2.50c. to 3c., Pittsburgh, for early shipment. An Eastern mill is now quoting plates at 2.75c. at mill. For future delivery 1.85c., Pittsburgh, is now the general quotation for plates. Steel bars and structural material are quoted at 2.25c. to 2.50c., Pittsburgh, for early delivery. There is a heavy demand for hard steel bars for early shipment for reinforcing purposes, and prices advanced during the week $1 per ton to 1.80c., Pittsburgh, but these prices have now been withdrawn and a further advance is expected. Bar iron has advanced $2 per ton, to 2c., Pittsburgh. The sheet market quieted down during the holidays and prices are unchanged. We quote black sheets at 2.50c. to 2.75c., at mill, for No. 28; blue annealed at 2.35c. to 2.60c. for No. 10, and galvanized at 4.75c. to 5.25c. for No. 28. Warehouse prices are unchanged at 2.50c. for steel bars, plates and structural material; 2 in. and larger rounds, 3c.; 2 in. and larger squares, 2.65c.

Bolts, Nuts and Rivets.—Bolt and nut specifications on contracts expiring within the year were very heavy, and there is considerable inquiry for new contracts, but some of the makers are not inclined to take contracts. Prices are firm and there is a probability of another advance shortly. Rivets are in good demand, with prices unchanged at 2.50c., Pittsburgh, for structural and 2.60c. for boiler rivets in carload lots.

Old Material.—The market has not recovered from the usual holiday dullness, but a renewal of activity is expected before the end of the week. Many mills held back on shipments during the holidays and but few dealers tried to make sales. Some heavy melting steel is being offered at $17, but $16.50 appears to better represent the market for ordinary stock. In the absence of transactions quotations generally are unchanged. We quote, f.o.b. Cleveland, as follows:

Per Gross Ton

Old steel rails	$15.75 to $16.00
Old iron rails	19.00
Steel car axles	23.00 to 24.00
Heavy melting steel	16.50 to 17.00
Old carwheels	14.00 to 14.50
Relaying rails, 50 lb. and over	22.50
Agricultural malleable	14.00 to 14.25
Railroad malleable	16.75 to 17.25
Steel axle, turnings	13.50 to 14.00
Light bundled sheet scrap	12.75 to 13.25

Per Net Ton

Iron car axles	$23.00 to $24.00
Cast borings	8.00 to 8.25
Iron and steel turnings and drillings	7.75 to 8.00
No. 1 busheling	14.25 to 14.75
No. 1 railroad wrought	17.00 to 17.50
No. 1 cast	13.00 to 13.50
Railroad grate bars	10.50 to 11.00
Stove plate	9.50 to 10.00

Birmingham

BIRMINGHAM, ALA., Jan. 3, 1916.

Pig Iron.—January enters with Birmingham pig iron firm at a minimum of $15 so far as manufacturers are concerned. If there is anything under that it must be resale iron. In some instances as high as $15.50 for spot is being secured. The leading interest quotes $15 for first half and $16 for second half. The trade is featured by an apparent anxiety on the part of many consumers to secure second half needs at the present quotation of $16 for that delivery. This inquiry has been so strong that the leading foundry producer on Friday last advanced the price of second half iron to $16.50 and made sales of two small lots at that figure. This interest is so well taken care of for the first half that it may almost be said to be out of the market except for regular customers. In a general way, manufacturers with one exception have booked from 60 to 75 per cent of their productive capacity for the first half. Charcoal iron is still in good demand, selling around $23 to $24. The output of Clifton iron will be increased this month by the blowing in of the repaired stack at Ironaton of the Alabama Company. The Sloss-Sheffield Steel & Iron Company will build an additional stack at Sheffield. This will give that company three fine stacks in extreme northern Alabama. The output of these furnaces enjoys a regular freight differential of 25 to 50c. by all rail in competitive territory and one of $1 by barge line to northern Mississippi River gateways. The initial shipment by barge line from Florence and Sheffield was made the past week.

It was a lot of 1000 tons for Chicago and will be transferred from barge to rail at Metropolis. Railroads must accept the barge-carried metal as though it came by connecting rail lines. A sale of 1000 tons of high manganese iron for last half delivery was made at $17. The year has started with more industrial wheels going than ever before in the history of Alabama. We quote, per gross ton, f.o.b. Birmingham district furnaces, as follows:

No. 1 foundry and soft	$15.50 to $16.00
No. 2 foundry and soft	15.00 to 15.50
No. 3 foundry	14.50 to 15.00
No. 4 foundry	14.25 to 14.75
Gray forge	14.00 to 14.50
Basic	15.00 to 15.50
Charcoal	23.00 to 23.50

Cast-Iron Pipe.—The week has been uneventful and the new business expected has not yet materialized. Pipe makers, however, agree that the general trend is a good one with prospect of increasing output. Latin-American sanitary pipe business offering has been handicapped by the instability of freight rates, which are changed frequently, thus militating against contracts for future delivery. We quote, per net ton, f.o.b. pipe shop yards, as follows: 4-in., $24; 6-in. and upward, $22, with $1 added for gas pipe.

Coal and Coke.—Prices for coal are slightly stiffening and coal men, for the first time in eighteen months, express themselves as really sanguine with regard to the future. Coke continues in strong demand and firm. There is no difficulty in disposing of the best 72-hr. foundry coke at $3.75. There is practically no by-product coke for the general market. We quote, per net ton, f.o.b. oven, as follows: Beehive furnace, $2.75 to $3; foundry, $3.25 to $3.50, with some brands as high as $3.75; by-product, 25c. under beehive.

Old Material.—Dealers report yards well cleaned up and a brisk demand for all steel grades as well as country wrought and stove plate. Prices quoted are firmly maintained. We quote, per gross ton, f.o.b. dealers' yards, as follows:

Old iron axles	$14.50 to $15.00
Old steel axles	14.00 to 14.50
Old iron rails	13.50 to 14.00
No. 1 railroad wrought	10.50 to 11.00
No. 2 railroad wrought	9.50 to 10.00
No. 1 country wrought	9.00 to 9.50
No. 1 machinery cast	10.00 to 10.50
No. 1 steel scrap	10.00 to 10.50
Tram carwheels	10.00 to 10.50
Stove plate	8.00 to 8.50

St. Louis

ST. LOUIS, MO., Jan. 3, 1916.

Pig Iron.—The year closed with increased buying interest and the aggregate sales increased over recent weeks, despite the five-day period for business. Prices are more and more firmly held. The sales during the week included 500 tons of malleable, 500 tons of No. 2 Northern foundry, 600 tons of No. 2 Southern and 750 tons of No. 2 Northern, while there was a very large number of sales in lots from 300 tons down, mostly for first half, with some few running into the last half. Specifications are running ahead of the contract requirements. The week closed with about 2500 tons out on inquiry. Ferromanganese is wanted and the quotation here is $115 per ton.

Coke.—Contracting is beginning for the new year though most of the contracts of this territory run from July to July. By-product coke from the local plant continues to dominate the market except where special brands are wanted, though quoted on the Connellsville basis.

Finished Iron and Steel.—Buying has continued heavy in the aggregate, though no large individual contracts were reported. Fabricators are busy and report increased building and other operations in sight demanding structural material. Tank plates are wanted more than they have been, especially for car building. The Missouri, Kansas & Texas has contracted for 1500 more steel underframe coal cars in pursuance of its policy to replace all its wood underframes. Some tentative inquiries for steel rails are out, but no closing of contracts as yet, though 15,000 tons may be bought by a Southwestern road shortly. Light rails are in increasing demand. Track fastenings are in good request. Ordinary and reinforcing bars are wanted, but not easy to get. Agricultural and vehicle interests are increasingly busy. Movement out of warehouse of stock for immediate use continues heavy and the high prices now asked are readily paid. We quote for material out of warehouse as follows: Soft steel bars, 2.35c.; soft iron bars, 2.30c.; structural material, 2.45c.; tank plates, 2.45c.; No. 10 blue annealed sheets, 2.75c.; No. 28 black sheets, cold rolled, one pass, 3.00c.; No. 28 galvanized sheets, black sheet gage, 5.10c.

Old Material.—Scrap has been in sharp demand and prices are firmly held at the quotations given. Both consuming interests and dealers are buying and the railroad supplies placed on the market are going at good prices. Relaying rails are active and there is increasing difficulty in getting supplies, especially in the lighter weights, in consequence of which consumers are being compelled to buy new rails. Mills, foundries and other consuming interests are taking out their contracts, and while they are inspecting with due regard for the higher prices paid there is not an extremely technical view taken of material where it can be made of use. We quote dealers' prices, f.o.b. customers' works, St. Louis industrial district, as follows:

Per Gross Ton

Old iron rails	$15.50 to $16.00
Old steel rails, rerolling	17.00 to 17.50
Old steel rails, less than 3 ft	16.50 to 17.00
Relaying rails, standard section, subject to inspection	21.00 to 23.00
Old carwheels	13.50 to 14.00
No. 1 railroad heavy melting steel scrap	15.50 to 16.00
Heavy shoveling steel	13.50 to 14.00
Frogs, switches and guards, cut apart	15.50 to 16.00
Bundled sheet scrap	10.00 to 10.50

Per Net Ton

Iron angle bars	$15.00 to $15.50
Steel angle bars	14.00 to 14.50
Iron car axles	20.00 to 20.50
Steel car axles	21.00 to 21.50
Wrought arch bars and transoms	17.00 to 17.50
No. 1 railroad wrought	14.50 to 15.00
No. 2 railroad wrought	14.00 to 14.50
Railroad springs	14.50 to 15.00
Steel couplers and knuckles	15.00 to 15.50
Locomotive tires, 42 in. and over, smooth inside	14.50 to 15.00
No. 1 dealers' forge	12.00 to 12.50
Mixed borings	8.50 to 9.00
No. 1 busheling	12.50 to 13.00
No. 1 boilers, cut to sheets and rings	10.00 to 10.50
No. 1 railroad cast scrap	13.00 to 13.50
Stove plate and light cast scrap	10.00 to 10.50
Railroad malleable	12.00 to 12.50
Agricultural malleable	10.50 to 11.00
Pipes and flues	10.00 to 10.50
Railroad sheet and tank scrap	10.00 to 10.50
Railroad grate bars	9.50 to 10.00
Machine shop turnings	10.00 to 10.50

San Francisco

SAN FRANCISCO, CAL., Dec. 28, 1915.

In some lines new business has been coming out more freely than usual at this season. There is more figuring for new building and miscellaneous construction projects than for many months, and jobbers note signs of greater buying activity among the small trade. Prices are very irregular in most lines, depending on the delivery available and the condition of the mill quoting. Local resale prices are keeping pace with the general upward movement.

Bars.—Local mills are still largely occupied with foreign business, much of which was taken at much lower prices than now prevail, but most of these old contracts will be disposed of within a couple of months. There is still considerable inquiry from the same sources. Local sales have not increased greatly, but there is a good tonnage of reinforcing business in prospect. General manufacturing requirements also are increasing, and material for early delivery commands stiff prices. Local mills quote 2.40c. on new business.

Structural Material.—The building outlook has improved greatly. Plans are on the boards for some office buildings of first-class importance, as well as for numerous factories and warehouses. The Ralston Iron Works has 300 tons for the Sacramento Hall of Justice, and the Pacific Rolling Mill Company has been awarded the University job. Dyer Brothers have taken

both jobs on the local city hospital, amounting to over 1000 tons, besides 150 tons for a women's club. It is reported that the Southern Pacific Railroad is planning to build a large office building on Market Street.

Plates.—The letting of construction contracts involving plate tonnage has been exceptionally active the last few weeks. The city of Los Angeles has taken bids on a lot of riveted pipe, requiring 2500 tons of plates and 1500 tons of blue annealed sheets. The Associated Oil Company has let contracts for six 55,000-bbl. oil tanks at Avon, Cal., as well as many stills, etc., and other important contracts have been let by the Shell Company. Several new shipbuilding contracts have also been placed. The building of a battleship at the Mare Island Navy Yard will be an important item in the local tonnage. The small trade shows signs of reviving, and merchants are anxious to get as early delivery as possible on their specifications.

Sheets.—With mill agents apparently disposed to avoid rather than seek new business, local buyers are showing a little more interest, at least in blue annealed. Galvanized sheets are also the subject of a little more inquiry, though the demand is not heavy.

Wrought Pipe.—Oil development is retarded by the Government's suit against many operators, but an early adjustment is hoped for. Aside from this, the urgent and heavy demand for boiler tubes is the principal feature. The greatest demand is from the railroads, but other shops also are getting into the market. Jobbing trade in the smaller sizes is picking up a little, and indications favor a marked expansion of business by spring.

Cast-Iron Pipe.—Business is seasonably dull, the only recent inquiry being for a fire protection system at the Benicia Arsenal. A number of municipal water projects, however, are expected to come up for figures in the near future. Prices are quite firm at the last quotations of $33 per net ton for 6-in. and over; $35 for 4-in., and $1 extra for class A and gas pipe.

Pig Iron.—While business has been rather quiet the last week, a good many inquiries are coming out, as stocks of foreign iron are getting low and foundry operations promise to be a little more active. Some of the leading Southern furnaces represented here, however, are noticeably less anxious to accept contracts, either for second or third quarter shipment, and prices remain very firm. No. 1 Southern foundry iron, however, is still available at about $26 per gross ton.

Coke.—The demand continues active notwithstanding the season, and a good many new contracts are coming out for extended delivery. Eastern coke is still quoted at about $15 per net ton, San Francisco.

Ferromanganese.—There is considerable demand, and while no business is yet reported at the new advanced prices, sales are expected shortly.

Old Material.—Steel melting scrap continues active, and from present indications no curtailment in requirements is likely for at least a year. Dealers are accordingly very firm in their views. While some of the melters still get all they want from outside points at comparatively easy prices, the tendency is upward. The general range is about $8 to $11 per gross ton. Cast scrap is a little quiet at the moment, but more activity is expected after the first of the year.

The Dunham, Carrigan & Hayden Company, San Francisco, has moved its offices and general hardware stock into its new four-story brick building at Kansas and Division streets. The building formerly used for hardware will be remodeled to accommodate the steel stock.

The Phoenix Iron & Steel Company, of Galveston, Tex., and New Orleans, La., has opened an office in Rooms 2302-2304 Woolworth Building, New York. The company handles iron and steel products, scrap and relaying rails, and iron and steel scrap either for export or for domestic consumption. The president of the company, now located in New York, is Leonard Joseph, who as vice-president of the Joseph Joseph & Brothers Company established the New York office of that company about fifteen years ago.

Chicago

CHICAGO, ILL., Jan. 4, 1916.—(*By Wire.*)

Even the deterrent influences of the holiday week and inventory period failed to check completely the flow of business millward. In one instance daily specifications in excess of 20,000 tons are reported as having been received. With respect to new business, manufacturers state that they have on file numerous letters from customers authorizing the booking of orders for from 5000 to 10,000 tons of steel for second half delivery as soon as the mills are willing formally to do so. From various sources rail orders of the week have materialized in an aggregate of 40,000 tons. With regard to prices, while there has been no announced advance from the basis of 1.80c., Pittsburgh, on steel bars, plates and shapes, prices at least $1 per ton higher appear to be the minimum, and considerable tonnage has been taken in this territory by outside mills for second half delivery at 1.90c., Pittsburgh, and at 2.10c. for earlier shipment, while for prompt shipment as high as 2.25c., Pittsburgh, continues to be paid. The pig-iron market is temporarily quiet, but the week marks an advance in malleable Bessemer to $19 at Chicago furnace.

Pig Iron.—Except inquiry for a moderate tonnage of basic iron, the market shows little unclosed business carried over into the new year. The holiday week was quiet, but the interested attitude of consumers will doubtless render this lull of short duration. The market for local iron is strongly on the basis of $18.50 at furnace for foundry iron, while for malleable Bessemer an advance to $19 is announced. For Southern iron $15.50 was done last week on several contracts for first half and $16 for second half, while one interest has raised its second half price to $16.50. The following quotations are for iron delivered at consumers' yards, except those for Northern foundry, malleable Bessemer and basic iron, which are f.o.b. furnace, and do not include a switching charge averaging 50c. per ton:

Lake Superior charcoal, Nos. 2 to 5	$19.25 to $19.75
Lake Superior charcoal, No. 1	19.75 to 20.75
Lake Superior charcoal, No. 6 and Scotch	20.25 to 21.25
Northern coke foundry, No. 1	19.00
Northern coke foundry, No. 2	18.50
Northern coke foundry, No. 3	18.00
Southern coke, No. 1 f'dry and 1 soft	19.00 to 19.50
Southern coke, No. 2 f'dry and 2 soft	18.50 to 19.00
Malleable Bessemer	19.00
Basic	18.00
Low phosphorus	32.00 to 36.00
Silvery, 8 per cent	26.50
Silvery, 10 per cent	27.50

Bars.—It is expected that a closing of considerable new tonnage of bars for export will be effected in the first two weeks of the year. Domestic users of steel bars are also asking the mills to take care of them on substantial tonnages for second half rolling. The bar-iron mills are asking a little more for that material, and sales at 1.80c., Chicago, are more common, with deliveries still fairly prompt. We quote mill shipments, Chicago, as follows: Bar iron, 1.75c. to 1.80c.; soft steel bars, 1.989c.; hard steel bars, 1.80c. to 2c.; shafting, in carloads, 50 per cent off; less than carloads, 45 per cent off.

We quote store prices for Chicago delivery: Soft steel bars, 2.30c.; bar iron, 2.30c.; reinforcing bars, 2.30c., base, with 5c. extra for twisting in sizes ½ in. and over and usual card extras for smaller sizes; shafting 35 per cent off.

Rivets and Bolts.—The difficulty of securing wire rods is now confronting the makers of bolts, and operations on a scale comparable with orders are in some instances impossible through lack of raw material. Under such circumstances prices are decidedly firm. We quote as follows: Carriage bolts up to ⅝ x 6 in., rolled thread, 70-12½; cut thread, 70-5; larger sizes, 65; machine bolts up to ⅝ x 4 in., rolled thread, with hot pressed square nuts, 70-10-7½; cut thread, 70-12½; larger sizes, 65-10; gimlet point coach screws, 75; hot pressed nuts, square, $4.70 off per 100 lb.; hexagon, $4.50 off. Structural rivets, ¾ to 1¼ in., 2.60c. to 2.65c., base, Chicago, in carload lots; boiler rivets, 10c., additional.

We quote out of store: Structural rivets, 2.60c.; boiler rivets, 2.70c.; machine bolts up to ⅞ x 4 in., 70-12½; larger sizes, 65-10; carriage bolts up to ⅞ x 6 in., 70-5; larger sizes, 65 off; hot pressed nuts square, $4.50, and hexagon, $4.70 off per 100 lb.; lag screws, 75.

Cast-Iron Pipe.—The city of St. Paul is in the market for 1500 to 2500 tons. At Madison, Wis., bids are being asked on 600 tons. Prices have been advanced 50c. per ton. We quote as follows per net ton, Chicago: Water pipe, 4 in., $30.50; 6 in. and larger, $28.50, with $1 extra for class A water pipe and gas pipe.

(*By Mail*)

Rails and Track Supplies.—The week brought out very little of importance in connection with track materials, though the Northern Pacific is understood to have added in a small way to the tonnage of rail contracts recently placed. Specifications continue to come in very heavily. Prices are unchanged.

Structural Material.—Contracts placed last week included 1100 tons for extensions to the Illinois Malleable Iron Company's plant at Chicago, awarded to the Morava Construction Company; 6000 tons for the new open-hearth building at Gary, to be furnished by the American Bridge Company, which also took 500 tons of bridges for the Missouri, Kansas & Texas Railroad. The same road distributed an additional 1600 tons among the Wisconsin Bridge & Iron, Federal Bridge and Virginia Bridge & Iron companies. The Hansell-Elcock Foundry Company took 900 tons for an Elks Club building at Chicago. No additional car inquiry of note is reported, but the closing of outstanding inquiry is daily expected. The mill situation as to deliveries is unchanged, and for second half, while there has been no definite opening of books, specific tonnages are being scheduled. Numerous indications of an advance of $1 per ton to the basis of 1.85c., Pittsburgh, are appearing, and we quote for Chicago delivery from mill 1.989c. to 2.039c.

We quote for Chicago delivery of plain material out of store 2.40c.

Old Material.—The unmixed showing of strength which the scrap market has presented through several weeks past was less forceful last week in view of the liberal outpouring of material available for purchase, the general lack of interest on the part of consumers and embargoes at two or three plants, among them the Inland Steel Company. The week was accordingly one of comparative quiet. Railroad offerings of scrap include a very heavy list from the Pennsylvania lines, 5800 tons from the Chicago & Northwestern, 4200 tons from the Santa Fe and small lists from a few other roads. We quote for delivery at buyers' works, Chicago and vicinity, all freight and transfer charges paid, as follows:

Per Gross Ton

Old iron rails	$17.50 to $18.00
Relaying rails	19.50 to 20.50
Old carwheels	14.75
Old steel rails, rerolling	17.00 to 17.50
Old steel rails, less than 3 ft.	16.50 to 16.75
Heavy melting steel scrap	16.00 to 16.50
Frogs, switches and guards, cut apart	16.00 to 16.50
Shoveling steel	15.50 to 16.00
Steel axle turnings	11.75 to 12.25

Per Net Ton

Iron angles and splice bars	$17.00 to $17.25
Iron arch bars and transoms	18.00 to 18.50
Steel angle bars	14.50 to 15.00
Iron car axles	20.00 to 20.50
Steel car axles	22.00 to 22.50
No. 1 railroad wrought	16.00 to 16.25
No. 2 railroad wrought	14.25 to 14.75
Cut forge	14.25 to 14.75
No. 1 busheling	13.25 to 13.50
No. 2 busheling	9.25 to 9.50
Pipes and flues	12.00 to 12.50
Steel knuckles and couplers	15.00 to 15.50
Steel springs	16.00 to 16.50
No. 1 boilers, cut to sheets and rings	11.00 to 11.50
Boiler punchings	13.75 to 14.25
Locomotive tires, smooth	15.75 to 16.25
Machine shop turnings	8.75 to 9.00
Cast borings	7.75 to 8.00
No. 1 cast scrap	13.75 to 14.25
Stove plate and light cast scrap	11.00 to 11.50
Grate bars	11.00 to 11.50
Brake shoes	10.25 to 10.75
Railroad malleable	13.75 to 14.00
Agricultural malleable	11.50 to 12.00

Wire Products.—Little relief is in sight in the distribution of wire products, but prices are unchanged. We quote to jobbers as follows: Plain wire, No. 9 and coarser, base, $2.139; wire nails, $2.289; painted barb wire, $2.439; galvanized barb wire, $3.139; polished staples, $2.439; galvanized staples, $3.139, all Chicago.

Plates.—The selling of plates, in quantities too large to be desirable from the standpoint of the jobbers, continues easily possible on the basis of 2.25c., Pittsburgh, from mill. The demand covers a considerable tonnage. The construction at the yards of the Chicago Shipbuilding Company of a Norwegian bulk freighter, requiring about 1200 tons of steel, is an interesting feature attributable to the volume of the coastal shipbuilding business. We quote for Chicago delivery of plates from mill 1.989c. to 2.439c.

We quote for Chicago delivery of plates out of store 2.40c.

Sheets.—From a domestic standpoint the sheet market developed no change last week but new inquiry for export sheets is in the hands of the mills covering several thousand tons. A closing of some of this business is expected within ten days. Prices are as last quoted.

New York

NEW YORK, Jan. 5, 1916.

Pig Iron.—This week has seen little activity in the Metropolitan district, though just before Jan. 1 there was considerable buying of Buffalo iron for New England. The General Electric Company is understood to have closed for 6000 to 7000 tons on its inquiry for second half of 1916, and is now asking for some special iron. A St. Louis interest, which makes its purchases in New York, is in the market for 10,000 to 15,000 tons of basic iron which may be divided between Southern and Northern furnaces. Whatever Northern iron is taken will naturally come from the Chicago district. An Eastern pipe company is reported to have been a buyer, but it is a question if the reputed transactions are new. Buffalo furnaces show varying quotations. One interest there which has been selling on the basis of $18 at furnace for No. 2 X has advanced its price this week to $19, but there is still $18 iron to be had. In all directions there is the expectation that the large demand for steel will operate increasingly to maintain a tight pig-iron market, and buyers of iron are readily entertaining prices which a short time ago they were quite unwilling to consider. We quote at tidewater as follows for early delivery: No. 1 foundry, $20.25 to $20.75; No. 2 X, $19.50 to $20; No. 2 plain, $18.75 to $19.25. Southern iron at tidewater, $20 to $20.50 for No. 1 and $19.50 to $20 for No. 2 foundry and No. 2 soft.

Ferroalloys.—Ferromanganese, both British and domestic, is growing firmer with each week. While the new quotation of $110, seaboard, announced last week, is still unchanged for forward delivery, spot material is higher, small lots having sold for $125 to $130, seaboard. One British producer announces that he will be unable to deliver any more of the alloy prior to May this year. The rapidly advancing prices for manganese ore in England are regarded as important factors in the future of the ferromanganese market. Domestic producers are understood to be selling at $125 and higher, furnace, for either contract or spot material. One domestic ferromanganese operation of 1915 has been discontinued. Sales of small lots are reported for forward delivery of both foreign and domestic material. Inquiries in some cases are more active, with signs of increasing anxiety as stocks grow less. In spiegeleisen inquiries for from 2000 to 3000 tons for delivery well into 1916 are before the market but sales have been few recently. Ferrosilicon, 50 per cent, is still strong and high, the last quotation at $83 to $85, Pittsburgh.

Finished Iron and Steel.—Further price advances marked the close of 1915, these being for material out of warehouse and for bar iron and a higher asking price from Eastern plate mills. In the case of the last, no less than 2.50c., Pittsburgh, is the quotation, but so far no business has been done at this figure. Bar iron advanced another $2 so that it is now quoted at 2c., Pittsburgh, and exceedingly heavy specifications on con-

tracts were received by mills in the interim between the holidays. Quotations on steel bars are irregular but appear to be anything from 2c., Pittsburgh, upward. Plain structural material can be obtained in large lots and probably in a few weeks for 1.90c., with some probability of 1.85c. if the conditions are altogether to the liking of the steel mill. In car building lines about the only award covered 1000 gondola cars for the Missouri, Kansas & Texas, to be built by the American Car & Foundry Company, but another road is to be added to those which hold that present prices are too high, the Chicago Great Western, which now, it appears, is not going to buy the 500 box cars it had before the market. The Levgar Structural Company is conspicuous in the week's settlements for fabricated structures, having closed for 1200 tons for a machine shop for the Samuel L. Moore Corporation, Elizabethport, N. J., 1200 tons for the Zoebel Building, Twenty-ninth Street and Madison Avenue, 450 tons for the Nurses' Home, German Hospital, and 500 tons for the Marlin Rifle Company, New Haven. The Virginia Bridge & Iron Works has taken 1000 tons for several bridges for the Southern Railway and the Purcell-Knoblauch Hardware Company, Inc., Brooklyn, is to erect a 200 ton orphan asylum on Staten Island. We quote mill shipments of steel bars at 2.169c. and higher for moderately prompt deliveries; plates, 2.419c., New York; structural shapes at 2.069c. and higher, New York, and iron bars at 2.169c., New York. For warehouse buying we quote iron and steel bars and structural material at 2.50c. and steel plates at 2.60c.

Old Material.—Holiday and inventory taking have probably restricted trade considerably. Transactions have been light. Prices are steady. Brokers are paying about as follows to local dealers and producers, per gross ton, New York:

Railroad steel scrap or equivalent	$14.50 to $15.00
Heavy melting steel scrap, yard stock (E. Pa. spec.)	13.00 to 13.50
Relaying rails	21.50 to 22.00
Rerolling rails	16.00 to 16.50
Iron car axles	24.50 to 25.00
Steel car axles	26.50 to 27.00
No. 1 railroad wrought	19.50 to 20.00
Wrought-iron track scrap	17.75 to 18.25
No. 1 yard wrought, long	16.00 to 16.50
No. 1 yard wrought, short	15.00 to 15.50
Light iron	5.25 to 5.50
Cast borings	8.50 to 9.00
Wrought turnings	8.50 to 9.00
Wrought pipe	13.50 to 14.00
Old carwheels	13.75 to 14.00
Malleable cast (railroad)	12.50 to 13.00

Local foundries are still being hampered by irregular deliveries of pig iron and scrap routed over railroads now congested with export traffic. Scrap prices are, therefore, strong. Dealers' quotations to consumers of cast scrap are as follows, per gross ton, New York:

No. 1 cast (machinery)	$16.00 to $16.50
No. 2 cast (heavy)	15.00 to 15.50
Stove plate	11.50 to 12.00
Locomotive grate bars	11.50 to 12.00

Cast-Iron Pipe.—While no new municipal lettings have been announced, the inquiry from private gas and water companies continues active, and numerous contracts are being closed. Prices are strong. Carload lots of 6-in., class B and heavier, are quoted at $29 per net ton, tidewater, class A and gas pipe taking an extra of $1 per ton.

British Market Nominal

Iron Market Awaiting Maximum Prices—Ferromanganese Higher

(*By Cable*)

LONDON, ENGLAND, Jan. 5, 1916.

Iron and steel works are all under control and makers are practically unable to quote, awaiting official information regarding maximum prices which are due in a few days. Pig iron is firm and business more active. Hematite iron is also firm at 130s. with makers booked some months ahead. Tin plates are strong with sellers asking 25s. 6d. and upwards. American 4-in. billets are $55 c.i.f. Ferromanganese has been advanced to £22 15s. packed. Quotations, which are mostly nominal, are as follows:

Tin plates, coke, 14 x 20, 112 sheets, 108 lb., f.o.b. Wales, 25s. 6d., against 24s. 9d. to 25s. 3d. one week ago.

Cleveland pig iron warrants, 77s. 10d.

No. 3 Cleveland pig iron, maker's price, f.o.b. Middlesbrough, 76s. 9d.

Steel black sheets, No. 28, export, f.o.b. Liverpool, £17 15s., against £17 nominal a year ago.

Steel ship plates, Scotch, delivered local yards, £12, compared with £11 5s. last week.

Steel rails, export, f.o.b. works port, £11 5s. nominal.

Hematite pig iron, f.o.b. Tees, 130s. to 135s. nominal.

Sheet bars (Welsh), delivered at works in Swansea Valley, about £12 nominal.

Steel joists, 15 in., export, f.o.b. Hull or Grimsby, nominal and unquotable, against £12 5s. as the last quotation.

Steel bars, export, f.o.b. Clyde, £16 10s. nominal.

Ferromanganese, f.o.b., £22 15s., compared with £20 15s. a week ago.

Ferrosilicon, 50 per cent, c.i.f., £27.

Finished Iron and Steel f.o.b. Pittsburgh

Freight rates from Pittsburgh in carloads, per 100 lb.: New York, 16.9c.; Philadelphia, 15.9c.; Boston, 18.9c.; Buffalo, 11.6c.; Cleveland, 10.5c.; Cincinnati, 15.8c.; Indianapolis, 17.9c.; Chicago, 18.9c.; St. Louis, 23.6c.; Kansas City, 43.6c.; Omaha, 43.6c.; St. Paul, 32.9c.; Denver, 68.6c.; New Orleans, 30c.; Birmingham, Ala., 45c.; Pacific coast, 73.9c. on plates, structural shapes and sheets and 65c. on wrought pipes and boiler tubes. The foregoing rates to the Pacific coast are by rail. The rate via New York and the Panama Canal is 56.9c.

Wire Products.—Prices to jobbers: Fence wire, Nos. 0 to 9, per 100 lb., terms sixty days or 2 per cent discount in ten days, carload lots, annealed, $1.95; galvanized, $2.65. Galvanized barb wire and staples, $2.95; painted, $2.25. Wire nails, $2.10. Galvanized nails, 1 in. and longer, $2 advance over base price; shorter than 1 in., $2.50 advance over base price. Woven wire fencing, 67½ per cent off list for carloads, 66½ off for 1000-rod lots, 65½ off for less than 1000-rod lots.

The following table gives the price per 100 lb. to retail merchants on fence wire in less than carloads, with the extras added to the base price:

Plain Wire, per 100 lb.

Nos.	0 to 9	10	11	12&12½	13	14	15	16
Annealed	$2.00	$2.05	$2.10	$2.15	$2.30	$2.40	$2.50	$2.60
Galvanized	2.90	2.95	3.00	3.05	3.10	3.25	3.60	3.70

Wire Rods.—Bessemer, open-hearth and chain rods, $40, nominally.

Structural Material.—I-beams, 3 to 15 in.; channels, 3 to 15 in.; angles, 3 to 6 in. on one or both legs, ¼ in. thick and over, and zees 3 in. and over, 1.80c. to 2c. Extras on other shapes and sizes are as follows:

	Cents per lb.
I-beams over 15 in	.10
H-beams over 18 in	.10
Angles over 6 in., on one or both legs	.10
Angles, 3 in. on one or both legs less than ¼ in. thick, as per steel bar card, Sept. 1, 1909	.70
Tees, structural sizes (except elevator, handrail, car truck and conductor rail)	.05
Channels and tees, under 3 in. wide, as per steel bar card, Sept. 1, 1909	.20 to .80
Deck beams and bulb angles	.30
Handrail tees	.75
Cutting to lengths under 3 ft. to 2 ft. inclusive	.25
Cutting to lengths, under 2 ft. to 1 ft. inclusive	.50
Cutting to lengths, under 1 ft	1.55

No charge for cutting to lengths 3 ft. and over.

Plates.—Tank plates, ¼ in. thick, 6¼ in. up to 100 in. wide, 1.90c. to 2.25c., base, net cash, thirty days. Following are stipulations prescribed by manufacturers:

Rectangular plates, tank steel or conforming to manufacturers' standard specifications for structural steel dated Feb. 6, 1903, or equivalent, ¼ in. and over on thinnest edge, 100 in. wide and under, down to but not including 6 in. wide, are base.

Plates up to 72 in. wide, inclusive, ordered 10.2 lb. per sq. ft., are considered ¼-in. plates. Plates over 72 in. wide

must be ordered ¼ in. thick on edge or not less than 11 lb. per sq. ft., to take base price. Plates over 72 in. wide ordered less than 11 lb. per sq. ft. down to the weight of 3/16 in. takes the price of 3/16 in.

Allowable overweight, whether plates are ordered to gage or weight to be governed by the standard specifications of the Association of American Steel Manufacturers.

Extras.	Cents per lb.
Gages under ¼ in. to and including 3/16 in.	.10
Gages under 3/16 in. to and including No. 8	.15
Gages under No. 8 to and including No. 9	.25
Gages under No. 9 to and including No. 10	.30
Gages under No. 10 to and including No. 12	.40
Sketches (including straight taper plates), 3 ft. and over	.10
Complete circles, 3 ft. in diameter and over	.20
Boiler and flange steel	.10
"A. B. M. A." and ordinary firebox steel	.20
Still bottom steel	.30
Marine steel	.40
Locomotive firebox steel	.50
Widths over 100 in. up to 110 in., inclusive	.05
Widths over 110 in. up to 115 in., inclusive	.10
Widths over 115 in. up to 120 in., inclusive	.15
Widths over 120 in. up to 125 in., inclusive	.25
Widths over 125 in. up to 130 in., inclusive	.50
Widths over 130 in.	1.00
Cutting to lengths under 3 ft. to 2 ft., inclusive.	.25
Cutting to lengths under 2 ft. to 1 ft., inclusive.	.50
Cutting to lengths under 1 ft.	1.55

No charge for cutting rectangular plates to lengths 3 ft. and over.

Wrought Pipe.—The following are the jobbers' carload discounts on the Pittsburgh basing card in effect from Aug. 16, 1915, on iron galvanized pipe, from Nov. 1, 1915, on iron black pipe, and from Jan. 4, 1916, on steel black and galvanized pipe, all full weight:

Butt Weld

Steel			Iron		
Inches	Black	Galv.	Inches	Black	Galv.
⅛, ¼ and ⅜	70	45½	⅛ and ¼	63	37
½	74	58½	⅜	63	37
¾ to 3	77	62½	½	67	47
			¾ to 2½	70	52

Lap Weld

2	74	59½	1¼	54	36
2½ to 6	76	61½	1½	65	47
7 to 12	74	57½	2	66	49
13 and 14	60½	..	2½ to 4	68	52
15	58	..	4½ to 6	68	52
			7 to 12	66	50

Reamed and Drifted

1 to 3, butt	75	60½	1 to 1½, butt	68	50
2, lap	72	57½	2, butt	68	50
2½ to 6, lap	74	59½	1¼, lap	52	34
			1½, lap	63	45
			2, lap	64	47
			2½ to 4, lap	66	50

Butt Weld, extra strong, plain ends

⅛, ¼ and ⅜	66	49½	⅜	60	43
½	71	58½	½	65	51
¾ to 1½	75	62½	¾ to 1½	69	53
2 to 3	76	63½	2 and 2½	70	54

Lap Weld, extra strong, plain ends

2	72	57½	1½	64	48
2½ to 4	74	59½	2	66	49
4½ to 6	73	58½	2½ to 4	68	52
7 to 8	67	50½	4½ to 6	67	51
9 to 12	62	45½	7 to 8	60	44
			9 to 12	55	39

Butt Weld, double extra strong, plain ends

½	61	48½	½	55	40
¾ to 1½	64	51½	¾ to 1½	58	43
2 to 2½	66	53½	2 and 2½	60	45

Lap Weld, double extra strong, plain ends

2	62	49½	2	56	40
2½ to 4	64	51½	2½ to 4	58	45
4½ to 6	63	50½	4½ to 6	57	44
7 to 8	57	40½	7 to 8	50	33

To the large jobbing trade an additional 5 per cent is allowed over the above discounts.

The above discounts are subject to the usual variation in weight of 5 per cent. Prices for less than carloads are two (2) points lower basing (higher price) than the above discounts on black and three (3) points on galvanized.

Boiler Tubes.—Discounts on less than carloads, f.o.b. Pittsburgh, freight to destination added, on lap-welded steel tubes and standard charcoal-iron tubes, effective from Dec. 1, 1915, are as follows:

Lap Welded Steel		*Standard Charcoal Iron*	
1½ in.	47	1½ in.	42 to 43
1¾ and 2 in.	59	1¾ and 2 in.	46 to 47
2¼ in.	56	2¼ in.	43 to 44
2½ and 2¾ in.	62	2½ and 2¾ in.	50 to 51
3 and 3¼ in.	67	3 and 3¼ in.	54 to 55
3½ to 4½ in.	68	3½ to 4½ in.	56 to 57
5 and 6 in.	61	5 and 6 in.	50 to 51
7 to 13 in.	58		

Locomotive and steamship special charcoal grades bring higher prices.

1¾ in., over 18 ft., 10 per cent net extra.

2 in. and larger, over 22 ft., 10 per cent net extra.

Sheets.—Makers' prices for mill shipment on sheets, of U. S. standard gage, in carload and larger lots, on which jobbers charge the usual advance for small lots from store, are as follows, f.o.b. Pittsburgh, terms thirty days net, or 2 per cent cash discount in ten days from date of invoice:

Blue Annealed Sheets

	Cents per lb.
Nos. 3 to 8	2.20
Nos. 9 to 10	2.25
Nos. 11 and 12	2.30
Nos. 13 and 14	2.35
Nos. 15 and 16	2.45

Box Annealed Sheets, Cold Rolled

Nos. 10 and 11	2.25
No. 12	2.25
Nos. 13 and 14	2.30
Nos. 15 and 16	2.35
Nos. 17 to 21	2.40
Nos. 22 and 24	2.45
Nos. 25 and 26	2.50
No. 27	2.55
No. 28	2.60
No. 29	2.65
No. 30	2.75

Galvanized Sheets of Black Sheet Gage

Nos. 10 and 11	3.75
No. 12	3.85
Nos. 13 and 14	3.85
Nos. 15 and 16	3.95
Nos. 17 to 21	4.10
Nos. 22 and 24	4.30
Nos. 25 and 26	4.45
No. 27	4.60
No. 28	4.75
No. 29	4.90

Iron and Industrial Stocks

NEW YORK, Jan. 4, 1916.

The market for securities the past week has been dominated by the situation with Austria-Hungary in regard to the sinking of passenger steamships carrying Americans. On the publication last Friday of the note from the government of that country conceding the conditions stipulated by our Government, the stock market advanced sharply. On Monday, however, the news that more passenger steamships had been sunk, apparently by Austro-Hungary submarines, prices underwent a severe decline. The range of prices on active iron and industrial stocks from Wednesday of last week to Monday of this week was as follows:

Allis-Chal., com.	30⅞- 32	Republic, com.	54 - 55¾
Allis-Chal., pref.	81 - 85⅞	Republic, pref.	109 -110
Am. Can, com.	59½- 62⅝	Sloss, com.	62½- 63½
Am. Can, pref.	111½-112	Sloss, pref.	99½-102
Am. Car & Fdy., com.	77 - 78¾	Pipe, com.	24½- 26⅜
Am. Car & Fdy., pref.	117½-118	U. S. Steel, com.	86⅞- 89½
Am. Loco., com.	68⅛- 69½	U. S. Steel, pref.	116⅝-117
Am. Loco., pref.	101 -101½	West. Electric	68¼- 69¾
Am. Steel Fdries.	60½- 62	Am. Rad., com.	390
Bald. Loco., com.	115½-119½	Am. Ship, com.	36
Bald. Loco., pref.	107½-108	Chic. Pneu. Tool	75 - 78
Beth. Steel, com.	450 - 467½	Cambria Steel	74 - 75½
Beth. Steel, pref.	145	Lake Sup. Corp.	9½- 9⅞
Case (J.I.), pref.	83¼- 88½	Pa. Steel, com.	51
Colo. Fuel	51¼- 53¼	Pa. Steel, pref.	82½- 83
Deere & Co., pref.	95¾- 96½	Warwick	10¼
Gen. Electric	173 -174⅞	Cruc. Steel, com.	70¾- 73½
Gt. No. Ore Cert.	49¾- 51⅞	Cruc. Steel, pref.	109 -111
Int. Harv. of N. J., com.	110 -111	Harb-Walk. Refrac., com.	70 - 71
Lackawanna Stl.	79 - 81⅝	Harb-Walk. Refrac., pref.	100
N. Y. Air Brake	137 -149½	Am. Brit. Mfg., com.	20 - 24
Nat. En. & Stm., com.	28¼- 29¼	Can. Car & Fdy., com.	82 - 86½
Pressed Stl., com.	63¾- 65	Can. Car & Fdy., pref.	102 -105
Pressed Stl., pref.	104 -105	Driggs-Seabury	140 -143
Ry. Steel Spring, com.	43⅝- 45	Midvale Steel	76 - 78¼

Dividends

The Youngstown Iron & Steel Company, regular quarterly, 1¾ per cent on the preferred stock, payable Jan. 1.

The Westinghouse Air Brake Company, regular quarterly, $2 a share, payable Jan. 21.

The Union Switch & Signal Company, regular quarterly, $1.50 a share on the common and preferred stocks, payable Jan. 15.

The Pittsburgh Gage & Supply Company, regular quarterly, 1½ per cent.

The Chicago Pneumatic Tool Company, regular quarterly, 1 per cent, payable Jan. 25.

The American Window Glass Machine Company, 7 per cent on the preferred stock, payable Jan. 7.

The H. W. Caldwell & Son Company, Chicago, has opened a sales and engineering office at 711 Main Street, Dallas, Tex., in charge of J. C. Van Arsdell.

Metal Markets

The Week's Prices

Cents Per Pound for Early Delivery

	Copper, New York		Tin,	Lead		Spelter	
Dec.	Lake	Electro-lytic	New York	New York	St. Louis	New York	St. Louis
29	22.25	22.25	39.45	5.40	5.35	17.50	17.25
30	22.37½	22.37½	40.00	5.40	5.35	17.50	17.25
31	22.50	22.50	40.50	5.50	5.40	17.50	17.25
Jan.							
3	22.87½	22.87½	42.50	5.50	5.40	17.50	17.25
4	22.87½	22.87½	44.00	5.50	5.40	17.50	17.25

NEW YORK, January 4, 1916.

Copper is higher and active, especially for export. Tin is higher and the market excited because of uncertainty over the safety of shipments afloat. Lead has advanced and is active. Spelter has been quiet and its quotation practically stationary, in marked contrast to the other metals. Spot antimony is again scarce and the quotation has advanced.

New York

Copper.—The situation is a mixed one. The market is strong, with electrolytic and Lake at 22.87½c., cash, New York, or 23c. thirty days, delivered, but the quotation for Lake is entirely nominal. None can be had this side of June, while electrolytic is well sold up to April. Producers are beginning to feel uneasy over their heavy future commitments, and some of them appear to be trying to avoid further orders as these would necessarily be for second quarter deliveries. Considerable talk is heard of a shortage in prompt metal, also of the heavy demand for prompt, but there is more or less skepticism with regard to both. Most of the consumers are known to be well covered. Foreign inquiry is heavy and is certain to result in a large volume of business, and it is on this situation that predictions of 25c. copper by the end of this month are based. The London quotation for electrolytic is £110, whereas a few weeks ago it was £88. The exports of December reached the excellent total of 32,936 tons, which is the record for the year, the next largest monthly total having been in March when 30,148 tons was exported. The base price of sheet copper was advanced Jan. 3 to 29c.

Copper Averages.—The average price of Lake copper for the month of December, based on daily quotations in THE IRON AGE, was 20.48½ and for electrolytic, 20.30c.

Tin.—Inquiry has been fair and each day more or less has been carried over to the next day, a situation which has resulted in a steady though moderate business ranging from 200 to 250 tons per day. Most of the interest has been in tin afloat or for shipment from the Far East, and as far ahead as March and April. On Dec. 30, when spot was quoted at 40c., about 250 tons of futures were traded in. The following day the market was active and closed with some of the demand again unsatisfied. On the last day of the year some of the brokers were busy in their offices until nine o'clock in the evening. A larger business would have been done if offerings had been freer, but these were scanty because of difficulty in getting licenses to ship from England. Yesterday about 250 tons in all positions was traded in, and late in the day the market became greatly excited over the report that the Japanese steamer Kenkon Maru, en route to London, had been sunk in the Mediterranean with several hundred tons of tin. The report that the steamer had large quantities aboard is yet to be confirmed. Sales were made all the way from 42c. to 43c., the market closing at the latter figure. To-day the London market is almost £1 higher, and this morning dealers named 44c. as the early asking price. Deliveries into consumption in December were large, amounting to 5200 tons.

Lead.—Buying of the past week has comprised many thousands of tons and the market is strong. The leading interest advanced its New York quotation last Friday from 5.40c. to 5.50c. and it is felt that another advance, probably $3 per ton, is impending. Prior to the advance, many of the sellers were asking premiums. The strong situation is largely due to heavy buying by Russia, both directly and through agents, added to which is other foreign buying, with a good demand from domestic consumers. The situation is very similar to that in copper, although not so acute. The St. Louis quotation to-day is 5.40c. The December exports totaled 6755 tons.

Spelter.—Throughout the week the market has been close to 17.25c., St. Louis, and 17.50c., New York, although quotations have varied considerably. The prices bid have usually been below these figures, at which sales were made. Inquiry has been fair only and practically confined to prompt and January shipments. January has sold at 17c., St. Louis. February is quoted at 16.25c., March at 15.50c. and second quarter at 14c. The December exports totaled 6103 tons.

Antimony.—Again there is a scarcity of spot antimony and the quotation for Chinese and Japanese grades has advanced to 41c., duty paid. Shipments are due here in the near future but these already have been sold.

Old Metals.—The copper market continues to advance and old metals are higher. Dealers' selling prices are as follows:

	Cents per lb.
Copper, heavy and crucible	20.00 to 20.50
Copper, heavy and wire	19.50 to 20.00
Copper, light and bottoms	17.50 to 18.00
Brass, heavy	13.00 to 13.50
Brass, light	11.00 to 11.50
Heavy machine composition	15.50 to 16.00
No. 1 yellow rod brass turnings	13.50 to 14.00
No. 1 red brass or composition turnings	13.50 to 14.00
Lead, heavy	5.00
Lead, tea	4.75
Zinc	12.00 to 14.00

Chicago

JAN. 3.—The metal market continues to show a rapid increase in values and we have revised our quotations accordingly. We quote: Casting copper, 22.50c.; Lake copper, 23.50c.; tin, carloads, 42c., and small lots, 44c.; lead, 5.45c.; spelter, 17.25c.; sheet zinc, nominally, 22c.; Cookson's antimony, 50c.; other grades, 45c. On old metals we quote buying prices for less than carload lots as follows: Copper wire, crucible shapes, 17.50c.; copper bottoms, 16.75c.; copper clips, 17.50c.; red brass, 15.50c.; yellow brass, 13.50c.; lead pipe, 4.90c.; zinc, 13c.; pewter, No. 1, 25c.; tinfoil, 33c.; block tin pipe, 37c.

St. Louis

Jan. 3.—Non-ferrous metals closed the year with lead at 5.60c.; spelter, 20c.; tin, 42c.; Lake copper, 24c.; electrolytic copper, 23c.; Asiatic antimony, 44c. In the Joplin ore district zinc blende reached $125 per ton, while the second grade ores sold as low as $90. Calamine was stronger at $65 to $80. Lead ore was higher at $72. Miscellaneous scrap metals are quoted as follows: Light brass, 7.50c.; heavy yellow brass, 9.50c.; heavy red brass and light copper, 11c.; heavy copper and copper wire, 13c.; pewter, 21c.; tinfoil, 30c.; zinc, 7.50c.; lead, 4c.; tea lead, 3.50c.

Soaring Prices for Manganese Ore

Still higher prices are being quoted for manganese ore in Great Britain than were reported in THE IRON AGE, Oct. 28, 1915. The official quotation of the London *Iron and Coal Trades Review* on Dec. 17, 1915, put 50 per cent. Brazilian ore at 4s (97c) per unit, c.i.f., United Kingdom, against 2s 9d (66c) on Sept. 24, 1915. For Indian ore, 50 per cent., the quotation on Dec. 17, last was 2s 5d (58c) and 2s 4½d (57c) both c.i.f. east and west coast respectively. These prices were 1s 8d (40c) and 13s 7d (38c) per unit, respectively, on Sept. 24, 1915.

Announcements are not yet available as to the policy of the Haskell & Barker Car Mfg. Company under the new regime, but it is well known that a tract of 2000 acres adjoining the present plant at Michigan City, Ind., is available for the building of steel works, and it is commonly accepted that a program looking to the utilization of this land is in a formative stage.

The Machinery Trade's Greatest Year

Production Inadequate to Meet Demand—Munitions Makers Lavish Buyers—Exports Heavy —Domestic Demand Awakened in August

BY CHARLES LUNDBERG

In the year just ended events without precedent were added to the annals of the machine-tool industry. The demand which came from the makers of munitions of war both at home and abroad was of a volume so mighty that hunting for buyers completely ceased. Buyers sought the sellers, and the great problem of the latter was finding machines wherewith to supply importuning customers. Tool-building shops were filled with as many men as could be worked. Night shifts were put on. Plants were extended. Machine parts were made in shops new to such work. Agents were employed to locate second-hand tools which might be purchased and then resold. Salesmen frequently sold in one lot as many machines as they would normally sell in one year. In the first quarter of 1915 dealers did a business which equaled or exceeded that of all 1914. Their business of the year tripled that of 1914. Deliveries were steadily forced further and further ahead, and in December many makers of standard machine tools could not promise deliveries until well into the coming spring; others required until July, and one maker of automatic machines could only quote on deliveries to be made in early 1917.

There was no exultation over this great influx of business; on the contrary, many were saddened by it. They would much rather have seen their machines taken for use in peaceful industry, and not for the production of death dealing appliances. Yet, modern wars are fought with machines in the making of which metal-working equipment is the chief essential, and the mission of the machine-tool builder is to supply the equipment demanded. It all demonstrated that warfare is as dependent on the metal-working machine as are innumerable constructive energies of men. In reality, as every government now perceives, machine-tool building practically constitutes an arm of the service.

PROBLEMS WERE MANY AND VEXATIOUS

Mixed with the perplexities of producing machines were others which were rendered more puzzling by the lack of guiding precedents. Contracts involved huge sums, and financial responsibilities had to be determined; many buyers were new and unknown; there was the horde of brokers and agents, many of them self-constituted speculators as a matter of fact; there was the possibility of cancellations and the need of guarding against them; and among other important considerations were the tying up of large sums in material, the problem of caring for the domestic industrial demand so far as it could be done, the uncertainties of the export situation, strikes, difficulties in transportation by rail and water. All told, it was a harrowing year for the industry, busy as it was, and many of its representatives on whom responsibility fell heaviest were worn out.

At the outset of 1915 the export demand was the chief feature, as it had been in the last few months of 1914, but the new year had not progressed far when there came the avalanche of orders for machines needed in the United States for the execution of contracts for shells and small arms. Tentative inquiry was out in December, 1914, for many such machines, but only a comparatively few firms were actually engaged in making shrapnel or high explosive shells. To-day hundreds of companies are making shells or some of their parts. Most of the larger companies, whose names have appeared within the year in THE IRON AGE markets have each purchased hundreds of tools; in fact, many deliveries on such purchases have yet to be made.

THE EARLY DEMAND WAS RESTRICTED

The early demand called principally for engine lathes, turret lathes and milling, drilling and grinding machines. In March orders were so numerous and heavy that a note of warning was sounded throughout the trade against the danger of cancellations, a fear which was natural in view of the placing of orders aggregating millions of dollars by firms taking up work with which they were not familiar. Stocks of standard machines of the types most in demand were exhausted in May, and at the railroad men's annual convention at Atlantic City only half a dozen tools were shown, in contrast to the scores which were exhibited at the same place the year before. In June, with the war demand still growing, domestic buyers became more active.

There was no midsummer dullness, and in August a strong industrial revival was in force. Prior to this time the demand for machines, at first largely restricted to a few kinds, had been widening to include others. The planing machine capacity of the machine-tool industry was entirely inadequate for the production of the vast number of lathes for which there was call. The planer builders became filled up with orders from the industry itself, which bought heavily of other machines also. Boring mills, for instance, required for the construction of gun mounts, became very active.

NEW FACTORS IN MACHINE-TOOL FIELD

A source of no little concern to the established makers of lathes was the appearance of many new competitors about the middle of the year. It was recognized that there was business enough for all, but it was feared that a bad situation would be created if any considerable number of these newcomers stayed in the business after the subsidence of the big demand. In normal times the facilities for producing lathes is more than ample. At least sixty additional concerns engaged in the manufacture of lathes. Some of these machines, built after well-proved designs and in good shops, were creditable products; others were strange creations and actually no more like a good standard engine lathe than the first locomotive resembled one of to-day. Many poor machines were sent abroad, and a prominent member of the trade has said that these machines may do harm that cannot be eradicated for years. One or two instances exist where companies found themselves in the lathe-building business more by accident than design. One company which had a shell order ventured to make lathes for its own use

because it could not buy them; others heard of what it was doing and requests for lathes began to come along. Late in the year the new makers of lathes were looking for business.

A development of the lathe situation was the so-called single-purpose lathe for the manufacture of shells; a machine shorn of all unnecessary attachments and accessories; short bed, and suitable only for the making of shells or something very similar to them. Many thousands of these machines have been built and disposed of in the year. In September there was a swing in demand in favor of larger lathes suitable for the making of big guns.

TRADE HARASSED BY STRIKES

In the last half of the year the machine-tool industry suffered widely from strikes, some of which have not yet been declared off. All were due to the pernicious activity of labor agitators, and oftentimes declared without any grievances, these being decided on after the men had walked out. The strike fever affected plants in Pennsylvania, New Jersey, Maryland, Connecticut, Rhode Island, Massachusetts, Ohio and Wisconsin. In several important plants compromises were reached; in others, the men returned to work without gain, and in all cases managers were steadfast in their stand against recognizing the union. The deliveries of some tool builders were put back six weeks to two months by these labor troubles.

Prices were advanced at various times in the year, some machines now bringing at least 30 per cent more than they did a few months ago, and with materials costing more and rapidly becoming scarce there is prospect of further advances. The trade suffered in recent months from the high cost of tool steel and the difficulty of getting it. In December some makers of tools withdrew prices to protect themselves against the rapidly advancing cost of materials. They continued willing to sell if purchasers would accept the offered deliveries, but their contracts stipulated that the price paid must be that prevailing at the time of delivery. Others sold with the proviso that they could advance their prices by giving three months' notice, the buyers in this case having the option of canceling. Others advanced their prices heavily at the inception of the demand, so that war contractors would figure the cost of machinery in their estimates.

In November it was seen that the English and French buying was tapering off materially, although Russian buyers continued active. There is promise of greater activity in Russia's behalf early this year. Great Britain gave the trade a shock in early December by the announcement of a partial prohibition of the importation of machine tools. The news mystified the trade until it was learned that importation would be permitted under license of the British Board of Trade. It was stipulated, however, that only firms that had been established two years, and whose annual business amounted to £10,000 per annum, would be allowed to import. Profits were also to be restricted.

The Character of Railroad Buying

But few good-sized railroad lists came out in the year, although the roads did considerable buying in a desultory sort of way, taking a machine or two for replacements as they were needed. The Seaboard Air Line and the Lehigh & New England each bought equipment for new shops in the year, and in late November the Great Northern announced that it was in the market for a large number of tools. For some time a large number of the railroads have followed the policy of keeping abreast of their machine-tool requirements by buying machines as they are needed instead of by wholesale replenishments. Letters received from over eighty high officials of as many different railroads indicate a continuance of the small-lot buying. The plan is one which holds many advantages for all concerned.

Most of the letters received in response to a request for information as to 1916 shop requirements expressed doubt as to extensive early buying. Several contained allusions to past purchases which are expected to suffice for a time. From a few of the replies the following extracts are taken:

OPINIONS FROM RAILROAD EXECUTIVES

Long Island.—This company expects to order about 20 tools of various kinds for its shops. Their value will be in the neighborhood of $30,000.

New York Central.—Our purchases will not be large, as we have during the past three or four years re-equipped our largest shops. However, we shall be in the market from time to time for miscellaneous tools for our shops to the extent of probably $50,000.

Missouri, Kansas & Texas.—The purchase of machine tools and shop equipment for this company and subsidiary lines during the year 1916 will probably amount to $90,000.

Chicago & Northwestern.—Our company has bought the average amount of machine tools, etc., annually, regardless of business conditions which prevailed at that particular time. We, therefore, have no shortage and expect to follow our usual custom and purchase probably $50,000 worth of tools for renewals, etc. In the year 1916 we think it would be a wise and commendable precaution on the part of the builders to reserve sufficient of their output to satisfy the demands of their regular customers.

Delaware, Lackawanna & Western.—As far as we know now, aside from the purchase of occasional tools to replace those that are worn out or antiquated, we do not expect to purchase during the coming year.

Southern Pacific.—Outside of small purchases to replace obsolete tools, it is not contemplated that our company will require any considerable quantity of tools during the coming calendar year.

Chicago Great Western.—We do not contemplate the purchase of a great deal of shop machinery in 1916, but will probably buy the following: One tool room lathe, one Sturtevant fan, one 2500-ft. electrically-driven air compressor and one high-speed rail saw.

Atchison, Topeka & Santa Fe.—Our budget will not be ready before the latter part of January or early in February. Our purchases, however, will be normal in volume if the supply is in any way equal to our requirements. It looks, however, as if we shall be able to buy practically no high speed tool steel, except at prohibitive prices, and we are already making plans to use low speed tool steel where possible during the shortage period. Our gross business promises to be heavy next year and we shall probably buy freely in all lines where supplies of material, raw or manufactured, are available at prices that we can afford to pay.

Union Pacific.—Will be in the market for a small portion of tools for 1916, and substantially nothing but repair and renewal work.

Mobile & Ohio.—As everyone knows, the year ended June 30, 1915, gave very unsatisfactory results to most of the railroads of this country, and while a considerable improvement has taken place in the first half of the fiscal year 1915-16, few well informed railroad managers consider themselves yet out of the woods. For this reason it is quite unlikely that this company will be largely in the market for machine tools or shop equipment before the close of the fiscal year ended June 30, 1916. If, however, this year turns out to be as good as now seems highly probable we think all the railroads will begin to consider their shop requirements in the first half of the fiscal year 1916-17.

Pere Marquette.—This road will not be in the market for any unusual quantity of machinery, at least during the next year. We have experienced no difficulties in deliveries to date. We would appreciate any action on the part of the manufacturers to arrange to protect the requirements of the railroads.

Grand Rapids & Indiana.—No decision has as yet been reached so far as this company is concerned, but it is probable we will spend about $10,000.

Queen & Crescent.—It seems to us that the present and prospective price and delivery conditions will force the railroads to restrict their purchases of machine tools and shop equipment as far as possible, having in mind that the present conditions are very abnormal, and that no doubt a little later considerable second-

hand machine tools and shop equipment will be available at reasonable figures.

Cleveland, Cincinnati, Chicago & St. Louis.—The Big Four is not going to be very heavily in the market for machine tools and shop equipment in 1916. We have made up our budget, and probably not to exceed $25,000 will cover our orders for the Big Four and possibly $3,000 or $4,000 for the Cincinnati Northern. We have provided ourselves pretty fully with such equipment in the last two or three years, and do not feel that we will have any considerable amount to spend.

Northern Pacific.—We are not now in the market for any new tools or equipment. We have not even yet made up our budget for 1916, and have not determined what to ask for in the way of tools. Our requirements will undoubtedly be quite small on account of our liberality during previous years.

Chicago & Alton.—This company will be in the market for no additional tools in 1916. We have in the past two years constructed, for a road of our mileage and importance, a very complete new locomotive machine shop and a modern steel car repair plant. Therefore, we are now well equipped for the maintenance of locomotives, freight and passenger cars, and will only purchase such tools in the future as are necessary to keep our plant up to its present standard.

Gulf & Ship Island.—We anticipate no improvements in the next twelve months. As a matter of fact, we are trying to catch our breath from what we have just gone through.

Virginian.—While we anticipate needing some shop machinery during the year 1916, we have delayed considering it seriously on account of the general situation in the machinery trade, and since, from our point of view, the situation has not developed sufficiently to give any assurance of the return to anything like normal conditions, we have decided to take no action at this time toward definite appropriation for shop machinery.

Grand Trunk Pacific (Canada).—At the present time we do not consider it probable that we will purchase much more than $4,000 or $5,000 worth of machinery in the coming year. Railroad development at the present time is restricted, due to the war conditions existing in our country.

El Paso & Southwestern.—Will be in the market for one 54 x 54-in. x 8-ft. planer, one 16 x 40-in. universal grinder, one high speed saw, one set standard locomotive scales, one 20 x 14-in. 4-side planer with 40-hp. motor, one 8-ft. x 10 x 14-in. flanging furnace and one 6 x 7-ft. forging furnace.

New York

NEW YORK, Jan. 4, 1916.

It was a subject of comment in the trade that Dec. 31 was one of the busiest days of late, important business engagements being scheduled for as late as 4.30 Friday afternoon. Perhaps never before was a year ended, or a new one entered, under such a pressure of demand. It is true that orders are a little lighter than they were in recent months, but the only reason for this is that deliveries are far off, and some who are in need of tools hesitate to commit themselves for so far ahead. On the other hand, there are those who figure that safety lies in getting their orders booked.

The foreign demand, as heretofore noted, shows a falling off. The general industrial demand, however, is of a most encouraging nature, and gives every promise of continuance. The Hyatt Roller Bearing Company, Harrison, N. J., which has a new shop under construction, has purchased a large quantity of equipment. The Morrow Mfg. Company, Elmira, N. Y., a branch of the Willys Overland Company, Toledo, Ohio, has been a steady purchaser for some time past. The Simplex Automobile Company, New Brunswick, N. J., has continued to buy.

About the middle of January one Eastern electrical company will finish a sub-contract for British 3-in. shells on which it has been working for several months, and it is not expected that it will be renewed. Another report of interest with regard to the shell business is that another Eastern company, which has been engaged on a shell contract, has sold its equipment to the Canadian Car & Foundry Company, and in the future will devote itself to its regular products. Efforts to secure confirmation met with more or less contradictory results. Collections from firms engaged in the making of munitions have become somewhat slower, which is attributable to their having exhausted the deposits they received with their orders.

The trade is interested in the confirmation of the report that the Midvale Steel & Ordnance Company has received an order from the French Government for 384,000 shells 8.8 to 11.8-in., valued at about $30,000,000. The company has appropriated a large sum for improvements and extensions, including machine shops.

The United States Government is in the market for a number of tools for the Brooklyn and Norfolk navy yards, including grinders, small lathes and fourteen 24-in. drill presses, the latter for delivery at Brooklyn.

The Pierce-Arrow Motor Car Company, Buffalo, has let contract to the Aberthaw Construction Company, Boston, for the construction of a laboratory and experimental building, 50 x 90 ft., two stories, at its plant, Elmwood Avenue and the New York Central Railroad belt line.

The Erie Aeroplane Mfg. Company, Vernon Center, N. Y., has been incorporated with a capital stock of $100,000 to manufacture aeroplanes. C. A. MacHenry, H. E. Papenberg, 115 Broadway, New York City, and H. C. Mason, Vernon Center, N. Y., are the incorporators.

The Hancq Company, Jamestown, N. Y., has been incorporated with a capital stock of $50,000 by S. Lawrence, J. A. Westman and A. F. Weber to manufacture textile machinery. A plant will be established.

An extension is to be made to the plant of the International Acheson Graphite Company, Buffalo Avenue and Portage Street, Niagara Falls, N. Y.

Bacon & Co., Attica, N. Y., and others have incorporated the Attica Package Company, Ltd., and will build a factory at Jackson Street and Erie Railroad for the manufacture of baskets, etc.

The Defiance Check Writer Corporation, Rochester, N. Y., has been organized, with a capital stock of $350,000, to manufacture check writers, addressing machines, registering devices and other office appliances. S. C. Ward, P. R. McPhail and F. S. Macomber, Rochester, are the incorporators.

The Roblin Holding Company, with offices at Welden Avenue and the Erie Railroad, Buffalo, has been incorporated to manufacture heating devices and has purchased a plant at Kensington Avenue and the Erie Railroad. The incorporators are Harry Roblin and Harry J. Lehman, 505 Walden Avenue, and Henry P. Burgard, 1968 Fillmore Avenue.

Philadelphia

PHILADELPHIA, PA., Jan. 3, 1916.

The Abrasive Material Company, James and Fraley streets, Philadelphia, has awarded contract to A. Raymond Raff, 1655 Thompson Street, for the construction of a two-story brick factory, 90 x 232 ft., to be erected at a cost of about $50,000. Stearns & Castor, Girard Building, Philadelphia, are the architects.

The Harrison C. Rea Company, 1027 Wood Street, Philadelphia, has been awarded contract for the construction of three factory buildings, including a two-story reinforced-concrete pumphouse, 37 x 45 ft., for the George W. Blabon Company, oil-cloth manufacturer, Nicetown, Philadelphia. Ballinger & Perrot, 1211 Arch Street, Philadelphia, are the architects.

The Autocar Company, Ardmore, Pa., manufacturer of automobile delivery cars, etc., is having revised plans drawn by Stearns & Castor, Girard Building, Philadelphia, for the construction of a three-story brick and steel automobile body manufacturing building, 275 x 300 ft. Bids will be taken within a few days.

Baltimore

BALTIMORE, MD., Jan. 3, 1916.

A plant for the manufacture of internal combustion oil engines from 5 to 1000 hp. will be built at Canton, Md., by the Baltimore Oil Engine Company, which has been incorporated at Dover, Del., with $1,050,000 capital stock. Alfred W. Gieske, Baltimore, is president, and Leon Wygodsky vice-president and general manager. Plans for the plant, 100 x 150 ft., are being prepared by Walter M. Gieske, architect, Baltimore.

Many tools were destroyed when fire wrecked the pipefitters' tool shop at the plant of the Prudential Oil Corporation, Curtis Bay, Md.

An additional story, 30 x 225 ft., is being built to the cot-

ton mill of the Electric Hose & Rubber Company, Wilmington, Del. About 60 braiding machines will be installed.

The Remington Arms Company, Eddystone, Pa., has leased a large amount of space in the old plant of the Duplex Metals Company.

The West Indies Sugar Company, Baltimore, Md., is in the market for Diesel oil engines.

The City Point Ice Corporation, Alexandria, Va., is in the market for a 72 x 18 horizontal boiler, with a 35-hp. steam engine, direct connected to a 30-kw. generator; a steam condenser for an ice machine and a steel stack.

Fire caused damage amounting to several thousands of dollars at the sheet-metal plant of E. A. Armstrong, First Avenue and First Street, Canton, Md., Dec. 22.

A machine shop, 120 x 140 ft., will be constructed by the Comas Cigarette Machine Company, Salem, Va.

New England

BOSTON, MASS., Jan. 3, 1916.

While the New England manufacturers are looking forward to a year of great prosperity, there are temporary obstacles to uninterrupted production. One of the most bothersome at the opening of the year is the embargo on freight which the New York, New Haven & Hartford Railroad and its connecting lines have been compelled to place upon many kinds of shipments. In a statement explaining the road's position, President Elliott said in part: "The New Haven road has on its rails to-day nearly 46,000 freight cars, which is about 8000 cars more than it had a year ago, and 12,000 more than in December, 1913. The result is that its tracks, terminals and other facilities are congested at many places."

The strike at the Chicopee Falls, Mass., plant of the New England Westinghouse Company has been settled through the intervention of the State Board of Arbitration. The striking toolmakers are to return to work Jan. 3, and the employee whose discharge brought about the strike is to be given employment by the company, but not in his former position.

The Rockwell-Drake Company, recently organized by Hugh Rockwell and L. A. Drake, is reported to be having plans drawn for a factory in Plainville, Conn. The chief product is to be ball bearings. Both Mr. Rockwell and Mr. Drake were formerly with the New Departure Mfg. Company.

A permit has been taken out for the first building of the new plant for the S. K. F. Ball Bearing Company, Hartford, Conn. It will be 180 x 209 ft., one and two stories, and is to be erected by the Stone & Webster Engineering Corporation of Boston.

The Excelsior Needle Company, which has plants in Torrington, Conn., and Springfield, Mass., has bought the Olmstead-Tuttle plant in Chicopee, Mass.

Control of the Standard Metal Works Company, Thompsonville, Conn., has been secured by Mark W. and Guy F. Bushnell through the purchase of the interest of the James Colvin estate. The company is incorporated for $75,000 and manufactures automobile parts. M. W. Bushnell becomes president and treasurer and G. F. Bushnell is secretary.

C. J. Bates & Son, Chester, Conn., have awarded a contract for a factory, 40 x 80 ft., two stories, and a one-story boiler house.

The National Electric Bulletin Corporation, New York, is reported to have awarded a contract for a factory at New London, Conn., where it will manufacture electric bulletin machines for newspaper and advertising purposes. Karl A. Staahlgren is president and general manager.

The Yankee Farm Tractor Company has been organized at Westfield, Mass., with capital stock of $50,000, to manufacture a tractor invented by E. R. Pendleton, who is the president of the company. The factory site has not been selected, but the company will probably locate in Westfield.

Plans have been drawn for a new rifle range building for the Hopkins & Allen Arms Company, Norwich, Conn., and President John A. McGregor has been quoted as stating that the manufacture of rifles would probably begin by March 1. A considerable force of draughtsmen are at work designing the necessary tools and fixtures, which are being made in a number of tool shops outside of Norwich.

The Tremper-Shields Company, recently organized at New Haven, Conn., will locate its plant in the Smedley Building on Brewery Street, New Haven. Charles W. Tremper is president and treasurer.

The Martin Rocking Fifth Wheel Company, Springfield, Mass., has been incorporated with capital stock of $50,000 to manufacture a device for turning an ordinary Ford car with semi-trailer into a one-ton truck or an ordinary one-ton truck into a three-ton truck. This device is the invention of Charles H. Martin, president of the company, who invented the Knox tractor. The office of the company is at 203 Bridge Street, Springfield.

The new buildings planned for the Stark Mfg. Company, New Bedford, Mass., are a four-story mill, 134 x 575 ft., a two-story office building, 50 x 110 ft., and a four-story storage building, 70 x 200 ft.

Chicago

CHICAGO, ILL., Jan. 3, 1916.

While neither manufacturers nor dealers look forward to as great an outpouring of inquiry and orders as appeared in 1915, there is already in sight a quantity of business that seems to assure for 1916 a full measure of activity; it appears likely that there will be less contrast this year between domestic and foreign business, for large increases in home manufacturing capacity are already projected. The coming spring is expected to bring with it a period of important plant extension and the resumption of inquiry which has been held in check because of delayed deliveries of machine tools.

The Four Wheel Drive Auto Company, Clintonville, Wis., is preparing a list of new tools which will be submitted as the basis of purchases to be made within the next ten days. It has orders greatly exceeding its present capacity, and will seek the promptest possible deliveries. The Root & Vandervoort Company, East Moline, Ill., which recently took a contract for the manufacture of large shells, has developed a specially designed lathe for the purpose; and its production of fifty per month will permit the disposition of fifteen lathes per month to the general trade, arrangements having been made with the R. E. Ellis Engineering Company, 549 West Washington Street, Chicago, for distribution in this territory.

The Wood Brother Thresher Company, Des Moines, Iowa, is building a machine and erecting shop, 100 x 256 ft., one story, which will double the output of its plant. R. L. Wood is secretary and treasurer.

The Western Chemical Company, Denver, Col., will spend the coming year about $100,000, which, with recent expenditures, will increase the capacity of its acid plant about 25 per cent.

Catalogs Wanted

The Western Machine & Foundry Company, Plattsmouth, Neb., has been established and is equipping a foundry and machine shop with the best obtainable machinery. It will do a general machinist business and will be glad to receive catalogs of tools, supplies, etc.

Cleveland

CLEVELAND, OHIO, Jan. 3, 1916.

The new year starts out with machine-tool builders from three to nine months behind on deliveries, the demand still heavy, and the volume of sales curtailed because buyers cannot get machines wanted. Single tools in some sizes can occasionally be picked up for early delivery, but round lots cannot be had for shipment before summer. The delay in deliveries also includes hammers, presses and other metal-working machinery. Following a heavy demand for machinery for munition work and the placing of large orders by the automobile industry, the market broadened until there was a good call for machine tools from about every metal-working industry, and this demand continues very active. Local machine-tool builders have increased the capacity of their plants about 100 per cent during the past year.

The demand for steel plant equipment, coke oven machinery and coal and ore handling machinery is very active. Considerable inquiry for steel-plant equipment has recently come from England, France and Canada. Russia is figuring on some steel plant equipment to be placed at the end of the war. Makers of chain hoists advanced prices about 10 per cent, effective Jan. 1. Second-hand machinery is in good demand, with a limited supply, some single machines bringing high prices.

The Morgan Engineering Company, Alliance, Ohio, has placed orders for additional heavy machinery amounting to about $100,000, which include a 15 x 10 x 26-ft. planer, a 60-in. milling machine, two floor-boring mills, eight lathes, two boring mills and two heavy radial drills.

The American Sheet & Tin Plate Company will erect an addition to its plant at Canton, Ohio, 50 x 156 ft.

It is stated that the Horan Stone Company, Maple Grove, Ohio, will make extensions and add equipment involving an expenditure of about $200,000.

The H. A. Lozier Motor Company, Cleveland, will soon establish its plant for the manufacture of automobiles. It plans to acquire floor space, and as the car will be largely an assembling proposition, little machinery will be required.

H. A. Lozier is president and F. H. Ginn secretary. Other stockholders are R. B. Sheridan, general manager Brown Hoisting Machinery Company; A. W. Foote and G. E. Randles of the Foote-Burt Company and F. F. Prentiss.

An extension to the plant of the Peerless Drawn Steel Company, Massillon, Ohio, is now under way, including two pickling buildings and a storehouse, providing 160,000 sq. ft. more floor space. When completed the capacity of the plant will be nearly 1000 tons of drawn steel per month.

The Cleveland-Ford Tire Company, Ashtabula, Ohio, will soon start the erection of its plant. It is stated that orders for the machinery equipment will be placed this month.

The Seneca Wire & Mfg. Company, Fostoria, Ohio, will enlarge its plant by the erection of a package and storeroom, two stories and basement, 125 x 150 ft., and a one-story cleaning and coarse wire department, 100 x 150 ft. The main factory will also be enlarged.

The Motor Drive Implement Company, Galion, Ohio, recently incorporated, will place on the market a tractor plow.

The Hercules Motor Mfg. Company, Canton, Ohio, recently organized to build automobile motors, has placed a contract for the erection of the first unit of its plant. This will be a two-story reinforced concrete building, 65 x 400 ft. It has acquired a five-acre site near the Aultman buildings. It has completed its organization by the election of Charles Balough, president; Gordon M. Mather, vice-president, and Oliver J. Strayer, secretary and treasurer. Mr. Strayer is at present secretary and treasurer of the Canton Stamping & Enameling Company. Others on the board of directors are H. H. Timken of the Timken Roller Bearing Company, John G. Obermier and L. Pulcher.

Charles Knight, general manager of the Knight Tire & Rubber Company, Canton, Ohio, has purchased a three-story factory, 60 x 150 ft., built by the National Products Company, but unoccupied for several years. No announcement has been made as to the purpose for which it will be used.

The Miller Rubber Company, Akron, Ohio, will enlarge its plant by the erection of two additional buildings, one eight stories, and also the extension of one of its present buildings. The Star Rubber Company, Akron, Ohio, will also enlarge its plant by the erection of a three-story building, 62 x 97 ft.

The Defiance Screw Machine Products Company, Defiance, Ohio, will enlarge its plant the coming spring by the erection of a single-story steel and brick building, 50 x 125 ft.

Cincinnati

CINCINNATI, OHIO, Jan. 3, 1916.

The last report issued by J. M. Manley, secretary Cincinnati branch National Metal Trades Association, for the quarter ended Dec. 15, 1915, shows 117 per cent of activity as compared with the quarterly report issued June 15, 1907, which ended the most active three months' period in the history of the machine-tool trade in Cincinnati. This showing is remarkable, as the report is based on the number of men employed in members' shops, and early in September a number of plants were handicapped on account of labor troubles. A conservative estimate to-day would show about 120 per cent of activity, as the strikers are returning to work.

A number of local firms made additions to their factories in 1915, and several large new plants are planned, work on which will begin early in the spring. The American Tool Works Company and the Oesterlein Machine Tool Company will both erect plants. The John A. Overheimann Foundry Company will also fit up a building on Colerain Avenue and will remove from its present location on Buck Street.

John A. Kelley, manager industrial department, Chamber of Commerce, Columbus, Ohio, includes the following in a list of firms in the metal-working lines that have either built new plants or added to their manufacturing facilities: American Lathe & Press Company, Solar Metal Products Company, Modern Die, Tool & Machine Company, Ohio Metal Company, Bonney-Floyd Company, Buckeye Steel Castings Company, Foster Gear Company, Shaw Wire Fence Company, Corrugated Container Company and others. The Dunlap Mfg. Company, lathe maker, will probably add to its manufacturing facilities at an early date. Labor troubles in Columbus last year were only of a minor nature.

Manufacturing building projects at Springfield, Ohio, include an addition to the plant of the Robbins & Myers Company, work on which will be commenced at an early date. In 1915 the Shuey Factories Building, a six-story reinforced concrete structure, was completed, and is now occupied by the Springfield Machine Tool Company and other manufacturing firms.

The labor situation is improving rapidly at Hamilton, Ohio, although several foundries and machine shops are either idle or working with reduced forces. The constant addition to the ranks of workmen is encouraging, and the strike bids fair to be at an end shortly.

The plant of the Ubiko Milling Company, Cincinnati, was almost completely destroyed by fire last week. It will be rebuilt as soon as insurance adjustments are made.

It is reported, and semi-officially confirmed, that the Union Gas & Electric Company, Cincinnati, is having plans prepared for a central power station.

The Fuelton-Greuter Mfg. Company, Saugas, Mass., manufacturer of automobile carbureters, will remove its plant to Cincinnati at an early date. A building at the corner of Sixth and Baymiller streets has been leased.

The Rudisell & Davis Motor Car Company, Cincinnati, will establish a public garage and repair shop on West Eighth Street.

The Manufacturers Production Company, Dayton, Ohio, has let contract to the Dayton Structural Concrete Company for a building, 60 x 350 ft., one story, of brick and concrete.

The American Lathe & Press Company, Columbus, Ohio, has been incorporated, with $100,000 capital stock, by E. Antrim, F. G. White and others. It was recently mentioned as having leased the idle plant of the Columbus Machine & Tool Company, and is an offshoot of a company having the same name, recently incorporated in Indiana with $1,500,000 capital stock.

Plans have been completed for a power plant to be erected at the Columbus State Hospital, Columbus, Ohio. H. S. Riddle is superintendent of construction for the board of administration.

Plans are under way for a power plant to be erected at Miller's Ford by the Dayton Power & Light Company, Dayton, Ohio.

The Miller Gas Engine Company, Springfield, Ohio, contemplates making additions to its plant.

The Smith Gas Engineering Company, Lexington, Ohio, has been incorporated with $450,000 capital stock by B. F. McCann and others. Manufacturing plans are not yet available.

The Grand Rapids Foundry Company, Grand Rapids, Wis., has declined several offers to build lathes for an Eastern company, because of its desire to continue the manufacture of its ice and refrigerating machinery. The plant is working at full capacity on domestic orders.

Milwaukee

MILWAUKEE, WIS., Jan. 3, 1916.

In spite of the increase in business in 1915 over 1914, the total volume is hardly up to that of 1913. It has hardly been really up to normal. The following figures will indicate the relative condition: The number of metal-working companies in this industry during both 1914 and 1915 was 80. In 1914 the number of employees was 15,422 and in 1915 it was 16,807, an increase of 8.9 per cent. Total wages for 1914 was $11,654,641 and in 1915 $13,011,253, an increase of 11.6 per cent. The amount of capital employed in 1914 was $47,349,965, compared with $48,026,400 in 1915, an increase of 1.4 per cent. The value of the 1914 product was $34,300,585, compared with $41,073,624 in 1915, an increase of 19.7 per cent.

It was the last half of 1915 that showed a substantial increase in new business received. The outlook for 1916 is encouraging in most respects. There is uncertainty in others, due to the war in Europe, labor conditions generally, the important political questions faced by this country, the attitude of Congress with regard to the tariff and the fact that 1916 is a Presidential year are factors which arouse conjecture. As to immediate business, it is stated that there has been the customary slackening for the holiday season, but this has not affected the production of machine tools. The automobile industry is renewing its demand for tools and asking deliveries late in 1916. Export demand continues brisk, although not nearly so strong as sixty days ago. This condition doubtless is due to the congestion of freight at Eastern terminals, as well as to the knowledge that builders are up to the extreme limits of capacity.

The Kissel Motor Car Company, Hartford, Wis., is rushing work on a building, 74 x 316 ft., three stories, to be ready Feb. 1. When completed, 250 to 300 workmen will be added to the payroll.

The E. R. Wagner Mfg. Company, manufacturer of hardware specialties and sheet-metal stampings, North Milwaukee, Wis., has amended its articles of incorporation, increasing its capital stock from $100,000 to $200,000 to accommodate the growth of the business. No extensions are contemplated.

The Carter Automobile & Machine Company, 522 Sixty-sixth Avenue, West Allis, Wis., is having plans prepared for

a machine shop, garage, etc., of brick and steel, 72 x 132 ft. C. M. Carter is president.

John Reed will establish a machine shop in the Weithaus Building, Burlington, Wis., and is now buying equipment.

The Goodman Lumber Company, Goodman, Wis., is installing a complete machine shop, to be managed by Osius Champagne, Marinette, Wis. The shop will do commercial work in addition to handling the company's sawmill and lumbering machine work. The equipment includes an oxy-acetylene welding and cutting installation.

William Long, Plymouth, Wis., is preparing to build a small machine shop and automobile repair station, 36 x 70 ft.

The Wisconsin Iron & Wire Works, 186 East Water Street, Milwaukee, will build a new plant at Booth and Franklin streets, Milwaukee. It has increased its capital stock from $30,000 to $80,000 for this purpose. Plans will be ready about Jan. 20. G. H. Norris is president.

S. E. Conley has established a garage and machine shop at Sharon, Wis., 50 x 70 and 40 x 60 ft.

The Western Fixture Company, 573-575 East Water Street, Milwaukee, has added a complete machine shop and enlarged its plating department.

The Lippow Cycle Company, Milwaukee, has been incorporated with $10,000 capital stock by Leo Lippow, Minnie Lippow and Norman L. Baker, attorney. It will operate a garage and machine shop at North Avenue and Seventh Street.

The Brillion Iron Works, Brillion, Wis., is installing a new core oven and making other improvements in its foundry. It has refused contracts for manufacturing war munitions because of the growing demand for its gasoline engines, silo fillers and other farm machinery.

Myron Savage, who recently retired from the Moll-Savage Motor Company, La Crosse, Wis., has purchased the entire mechanical department of the company and will conduct a general machine shop. Extension of floor space and equipment is contemplated.

Detroit

DETROIT, MICH, Jan. 3, 1916.

The Russel Motor Axle Company, Detroit, has increased its capital stock from $150,000 to $250,000 to provide for the erection of additions to its plant, including an assembling factory.

The Central Foundry Company, Marshall, Mich., has been organized to do a general foundry business. It has secured a plant 66 x 150 ft.

The De Free Chemical Company, Holland, Mich., has had plans prepared for an addition to its plant, 36 x 84 ft., four stories.

The Grand Rapids Dimmer Company, Grand Rapids, Mich., has been incorporated with $10,000 capital stock to manufacture automobile light dimmers. The incorporators are A. A. Flory, N. H. Davenport and M. D. Elgin.

The Central South

LOUISVILLE, KY., Jan. 3, 1916.

Machinery manufacturers here closed the year busier than at any time in 1915. Prospects are splendid. Even unseasonable lines of special equipment are in excellent demand, indicating that belated purchasers are finally getting into the market, or that next season's wants are being anticipated. Machine shops, foundries, forging plants and other iron-working establishments are all busy, and difficulty in getting plates is all that is keeping boiler shops from working overtime. Altogether, the machinery trade is entering the new year under extremely auspicious circumstances, and optimistic predictions regarding 1916 are being generally made.

The Cement Floor Tile Company, 539 Franklin Street, Louisville, is equipping a factory. S. W. Graves is manager.

The Jenkins Lubricating Company, Louisville, has established a plant at Third and Washington streets. It will make a mechanical lubricator, as well as lubricating materials. For the present the machine work will be done by contract.

Rufus Ashurst, Somerset, Ky., is in the market for logging equipment, including locomotives and cars, cables, drum-hoisting engines, rails, etc.

The Hazard Water Company, Hasard, Ky., was recently reorganized and will make extensions, including the installation of pumps and a filter plant. J. L. Morrison is general manager and engineer.

The South East Coal Company, Paintsville, Ky., is ready to receive bids on power and special equipment for its new mining plant. H. Laviers is manager.

The North American Fluorspar & Lead Corporation, Smithland, Ky., is asking for prices on steam or oil-burning hoisting engines.

W. S. Hendren, Nicholasville, Ky., is equipping a toy factory. Wood-working machinery is needed.

The John G. Duncan Company, 308 West Jackson Avenue, Knoxville, Tenn., is in the market for a gasoline hoisting engine, second-hand.

The Aluminum Company of America, Pittsburgh and New York, which has been planning the development of water power for use at its Maryville, Tenn., plant, has decided definitely to undertake the work. A series of dams, the first to be erected at Alcoa, Tenn., will be built across the Little Tennessee River, and large horsepower will be developed.

The Oldroyd Mfg. Company, Knoxville, Tenn., has been organized with a capital of $50,000 to manufacture coal-cutting machines. The incorporators are C. S. Oldroyd, J. R. Foster, E. H. Ford and others.

The Clinchfield Portland Cement Company, Kingsport, Tenn., is planning the expenditure of $400,000 for improvements and machinery, doubling the capacity of the plant.

The McNaughton Grate Bar Company, Maryville, Tenn., announces that it has received contracts for $40,000 worth of castings, and is considering enlarging its foundry. V. J. Adams is manager.

St. Louis

ST. LOUIS, MO., Jan. 3, 1916.

The year closed with conditions in the machine-tool market fully as active as at any time in the past few months, with the matter of delivery just as serious as ever. The search for second-hand tools, either in their present condition or after remodeling and rebuilding, continues as active as ever. From all character of industrial plants comes increasing pressure for new equipment. Loanable funds are in excessive supply, but the demand is slowly increasing, with rates still low. Collections are excellent.

The A. Wolf Iron & Metal Company, St. Louis, Mo., has increased its capital stock from $3,000 to $30,000 and will increase its yard and rehandling equipment.

The South Side Garage Company, St. Louis, Mo., has been incorporated with a capital stock of $15,000 by Joseph Magner, J. F. Carl Wegener, E. G. Oldendorph and others.

The Valley Park Mfg. Company, Valley Park, Mo., a suburb of St. Louis, has been incorporated with a capital stock of $150,000 by Henry M. Blossom, I. Folger and E. D. Blossom, and will equip with wood-working machinery.

The Jam Perfecto Bottle Cap Company, St. Louis, Mo., has been incorporated with a capital stock of $12,000 by John Januchowsky, Henry Albert and others.

The Booth-St. Louis Cold Storage Company, St. Louis, Mo., has been incorporated with a capital stock of $500,000 by W. H. Tumbruck, J. A. Corbett, B. W. Hilgard and Joseph C. Cannon to equip the cold-storage plant in St Louis to be controlled by the Booth Fisheries Company. W. H. Tumbruck is in charge.

The chief engineer's department of the St. Louis, Iron Mountain & Southern Railroad Company at St. Louis, Mo., states that the proposed machine shop at Monroe, La., recently reported, will not be erected at present.

The Serlis Motor Company, Kansas City, Mo., has been incorporated with a capital stock of $20,000 by Harry Serlis, Joseph Wolfe, Allen E. Reed, and others, and will equip a machine shop, etc.

The Good Roads Company, Kansas City, Mo., has been incorporated with a capital stock of $100,000 by Charles E. Logan, Cliff Roberts and H. G. Pope to manufacture road machinery.

The Major Stave Company, Ashdown, Ark., will equip a stave plant at Camden, Ark., of 10,000 staves per day capacity. R. E. Major is general manager.

The Pierce Oil Corporation, St. Louis, Mo., has announced plans for a factory for making paraffine and kindred products at Tulsa, Okla., to cost about $800,000.

The Western Tractor Company, Tulsa, Okla., has been incorporated with a capital stock of $50,000 by J. E. Duffey, F. W. Dye and P. M. Kerr and will establish a plant.

The Port Commissioners, New Orleans, La., will receive bids until Jan. 12 for pneumatic grain-unloading equipment.

The Mayor and Aldermen of Opelousas, La., will receive bids until Jan. 18 on one 150-hp. crude-oil engine, direct-connected to a 100-kw. alternating current generator, etc. A. C. Jones is superintendent.

The Pacific Northwest

SEATTLE, WASH., Dec. 27, 1915.

In the Pacific Northwest, and especially in Washington, the closing months of the year 1915 have brought a definite improvement in all lines of business, and prospects for 1916 are most encouraging. The belief is founded on the enormous grain crops, high prices for cereals, unparalleled growth of Seattle's oversea commerce and in the apparently sound improvement in the lumber and shingle trades. According to best authorities, about 65 per cent of the lumber mills are in operation, compared to 47 per cent six months ago.

Machinery men, particularly dealers in sawmill and shingle machinery, are confidently awaiting a busy spring and summer. Orders pending for some months are almost certain to be definitely placed now that the prices in lumber, shingles and logs are steadily increasing.

The Crossett Western Lumber Company, Portland, Ore., plans improvements to its plant which will cost more than $100,000. Steam power will be replaced with electric power, and entirely new equipment will be installed.

The Crane-Ordway Machinery Company, Great Falls, Mont., has awarded contract for large warehouse, 40 x 220 ft., for carrying a stock of casing and drilling supplies.

A. L. Hampton, Vancouver, B. C., plans the immediate construction of two box factories at Halls Lake, Wash. Ammunition boxes will be the chief product.

The Triumph Machinery Company, Portland, Ore., has been incorporated by F. L. Stewart, W. F. Magill and H. E. McKenney, with capital stock of $20,000.

The Ritzville Central Heating Company, Ritzville, Wash., has been incorporated by H. B. Spear, G. E. Lovell, David Hoefel, and others, for $200,000. It plans to install a heating system in Ritzville.

The F. S. Lang Mfg. Company, 2762 First Avenue, Seattle, will construct a two-story frame factory to be equipped with modern stove-making machinery.

The St. Helens Shipbuilding Company, St. Helens, Ore., is considering plans for enlarging its plant, with the installation of equipment for the construction of steel as well as wooden vessels.

Canada

TORONTO, Jan. 3, 1916.

Companies manufacturing war munitions continue to hold the first place in Canada. A number of shell companies have been formed, including the Transcona Shell Company, Ltd., Montreal, to take over the Transcona Shops at Winnipeg, Man., and install machinery to manufacture shells, etc. The Canada Cement Company, Montreal, is also installing machinery to manufacture shells. The Canada Foundries & Forgings, Ltd., Montreal, has received a large order to manufacture shells and will increase its plant capacity. The earnings of the majority of the steel plants is greatly in advance of what they have been for some time.

The Dominion Steel Corporation, Montreal, is now running to capacity in all departments and is booking business for export at prices hitherto unheard of in the steel trade of Canada. The demand for machine tools in 1915 was greater than in any year in Canada's history. In some cases it was impossible to get tools to equip plants for shell manufacture. A marked revival in the demand for structural and other steel has set in, and it is anticipated that these departments will be kept busy for some time.

The automobile trade in Canada last year was exceptionally brisk. It is expected that the demand for automobiles will continue. A number of companies have been recently formed to manufacture motor cars, accessories, etc., and those already operating plants are greatly increasing their output. The Canadian Crow Motor Company, Ltd., Mount Brydges, Ont., is erecting a factory. The Canadian Briscoe Motor Company, Ltd., Brockville, Ont., has been incorporated with a capital stock of $200,000 by Alfred O. Heather, James D. Smart and others. The Ford Motor Company, London, Ont., will build an addi on to its plant on Waterloo Street and will also build a tractor plant at Ford City, Ont. The Chevrolet Motor Company, Toronto, will build a plant at Oshawa, Ont.

Fire did about $100,000 damage to the factory of the Martin Corrugated Paper Company, Paper Avenue, Toronto. About $75,000 worth of machinery was totally destroyed.

The foundry of Leonard G. Holder, Lunenburg, N. S., was totally destroyed by fire.

The King-Beach Mfg. Company, Ltd., Mission City, B. C., is in the market for a steam boiler of about 50 hp.

The London Gas Engine Company, London, Ont., will build an addition to its factory to cost $40,000. The plant was recently purchased by W. H. Heard of the Spramotor Company.

The Halifax Tramway Company, Halifax, N. S., will make extensive additions to its plant to cost $500,000, including a gas plant and a machine shop, 146 x 150 ft.

The Grand Trunk Railway Company has commenced repairing its machine shop on Sebastopol Street, Montreal, which was recently destroyed by fire. The new building is to be of steel and brick construction. Some equipment will be required.

The Canadian Northern Railway Company, Ltd., King and Toronto streets, Toronto, has recently filed plans for a new townsite near Rideau, Ont., where it will erect its main line roundhouse, repair shops and car shops.

Reid, McGregor & Reid, 511 St. Catharine Street West, Montreal, has received the contract for the erection of a foundry for the Williams Mfg. Company, Ltd., 1789 St. James Street.

The Toronto Carpet Mfg. Company, 1179 King Street West, Toronto, will commence the erection of a temporary boiler room at Mowatt and Liberty streets to cost $20,000.

The Universal Tool Steel Company, Dufferin Street, Toronto, will build a one-story brick addition to its factory at a cost of $20,000.

The Canada Metal Company, Ltd., Fraser Avenue, Toronto, will build an addition to cost $25,000.

The Hammant Steel Car & Engineering Works, Kenilworth Avenue, Hamilton, Ont., plans to build an addition.

The St. Maurice Paper Company, Ltd., Montreal, has been incorporated with a capital stock of $10,000,000 by Alexander Chase-Casgrain, Erroll M. McDougall, John B. Henderson and others to manufacture wood pulp, paper, etc.

The Western Machinery Company, Ltd., Port Arthur, Ont., has been incorporated with a capital stock of $40,000 by Richard B. Roberts, Peter D. Munroe, Angus McPherson and others to manufacture boilers, shells, machinery, metals, etc.

The Consolidated Steel Company, Ltd., Toronto, has been incorporated with a capital stock of $100,000 by William H. Beatty, Francis A. Hammond, Charles B. McClurg and others to manufacture machinery, shells, boilers, rolling stock, etc.

The Ford Motor Company of Canada, Ltd., Ford City, Ont., has been granted a license to increase its capital stock of $1,000,000 to $10,000,000. It is making additions to its plant, and at London, Ont., will build a large tractor plant next spring. Mr. McGregor is the Canadian manager.

The National Cash Register Company of Canada, Ltd., Toronto, Ont., has been incorporated with a capital stock of $1,000,000 by John M. Godfrey, 76 Adelaide Street, West, Toronto; Thomas Phelan, 550 Kingston Road; John E. Corcoran and others.

The Irwin Vanfleet Company, Ltd., Hamilton, Ont., has been incorporated with a capital stock of $20,000 by Irwin Vanfleet, William W. Mapham, Edward A. Seagers and others to manufacture office furniture, fixtures, etc.

Government Purchases

WASHINGTON, D. C., Jan. 3, 1916.

Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, schedule 9165, for thirteen 12-in. powder conveyor hoists for Washington; schedule 9177, for miscellaneous accumulator pumps and accessories for Puget Sound; schedule 9180, for nine 12 x 1¼-in. emery grinding machines, thirteen handworkers' lathes, fourteen 24-in. drill presses, thirteen 26-in. bandsaws and eleven 12-in. saw tables, all for Brooklyn.

Sealed proposals will be received until 12 noon Jan. 24, by the quartermaster, West Point, N. Y., for two water-tube boilers and stokers.

Bids were received by the Bureau of Supplies and Accounts, Navy Department, Washington, Dec. 28, for supplies for the navy yards, as follows:

Schedule 9084, ordnance, class 43, Washington—One power-driven pipe-threading and cutting-off machine—Bid 15, $585.90 and $958.75; 41, $459.80, $490 and $568.35; 42, $1,200; 53, $905; 68, $1,015; 69, $1,095; 73, $900. Schedule 9085, construction and repair, class 51, Boston—Twenty-one machines for ropewalk—Bid 21, $13,115.

The names of the bidders and the numbers under which they are designated in the above list, are as follows:

Bid 15, Carroll Electric Company; 21, C. E. Dailey; 41, Kemp Machinery Company; 42, Landis Machine Company; 53, Manning, Maxwell & Moore; 68, Standard Engineering Company; 69, Swind Machinery Company; 73, Treadwell Engineering Company.